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# REVISED FEASIBILITY STUDY JASCO CHEMICAL CORPORATION MOUNTAIN VIEW, CALIFORNIA

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## EXECUTIVE SUMMARY

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This Feasibility Study (FS) is being performed to develop remedial objectives and identify and evaluate remedial action alternatives for the Jasco Chemical Corporation (JASCO) Site. Previous studies have indicated a need for corrective action to mitigate the impacts of chemical compounds present in Site soil and groundwater. Groundwater is defined as sub-surface water contained in the pore spaces between sediments below the water table. The Site is a chemical blending and repackaging plant located in the City of Mountain View, California and is presently operating. The Site is located in an area previously zoned for industrial use but more recently rezoned to provide for a transition to residential and research and development land-uses.

### E.1 INVESTIGATORY, REMEDIAL AND REGULATORY HISTORY

Soil and groundwater investigations at the Site began in May of 1984 in response to a request from the San Francisco Bay Regional Water Quality Control Board (RWQCB). In August of 1987, the RWQCB issued Cleanup and Abatement Order (CAO) No. 87-094 to Jasco, requiring remedial measures and the preparation of a remedial investigation/feasibility study. In response, JASCO conducted additional soil and groundwater investigations, evaluated remedial alternatives, and implemented several interim soil and groundwater remedial measures.

Interim remedial actions performed to date at the Site include:

- 1) the implementation of a groundwater extraction program within the A-aquifer to remove target constituents from groundwater and to prevent lateral and vertical migration of the target constituent plume;
- 2) excavation and off-site disposal of over 500 cubic yards of soil containing the highest concentrations of target constituents;
- 3) implementation of a runoff collection system to collect rain runoff and prevent percolation of surface water to A-aquifer groundwater;
- 4) removal and disposal of an underground storage tank previously used to store diesel fuel;
- 5) destruction of several dry wells; and
- 6) installation of a leak detection system at the present underground storage tank farm.

On June 24, 1988, EPA proposed the Site for inclusion on the National Priorities List (NPL). The Site was finalized on the NPL on October 4, 1989 with a hazard ranking score of 35.56. On December 21, 1988, EPA issued Administrative Order (Docket No. 89-01) which specified tasks to be completed by JASCO concerning the investigation and remediation of the Site. In compliance with this Order, JASCO has prepared and implemented the RI/FS and Sampling and Analysis Plan for the Site, completed additional soil and groundwater investigations, and prepared a final Remedial Investigation Report in addition to the interim remedial actions described above.

### E.2 NATURE AND EXTENT OF TARGET CONSTITUENTS

The target constituents detected in soil and groundwater at the Site fall under four main categories: volatile organic compounds, petroleum hydrocarbons, aromatic hydrocarbons and alcohols. The

volatile organic compounds detected are predominantly halogenated. Among the most persistent are 1,1-dichloroethane (1,1-DCA), 1,1,1-trichloroethane (1,1,1-TCA), and methylene chloride. The petroleum hydrocarbons detected at the Site fall within the range of paint thinner and diesel fuel. The aromatic hydrocarbons present include benzene, toluene, xylene and ethylbenzene. Because several of the aromatic hydrocarbons as well as diesel fuel have been detected in background samples collected away from potential sources, their presence at the Site does not necessarily reflect an on-site source.

#### E.2.1 Soil

Target constituents in soil are limited generally to a former drainage swale area at the northern property boundary along the SP railroad track although some target constituents have been detected in soil in the former diesel fuel storage tank area and in the present underground storage tank area. The soil excavation program conducted in the drainage swale area has removed the soil containing the highest concentrations of target constituents. In the eastern portion of the former drainage swale, surrounding the area previously excavated, target constituents are still present based upon data collected during the Remedial Investigation. In this area, the presence of target constituents in soil extends to the depth of groundwater, or approximately 30 feet. To the west of this area, the presence of target constituents appears to be limited to the upper three feet of soil. The drainage swale area contains approximately 1,100 cubic yards of soil which warrant remedial action due to the presence of target constituents. The estimated total volume of target constituents contained within this area is seven gallons of alcohols and volatile and aromatic hydrocarbons and 127 gallons of petroleum hydrocarbons.

The former diesel storage tank area contains approximately 37 cubic yards of soil which warrant remedial action. The target constituent present in this area are limited to petroleum and aromatic hydrocarbons with a total estimated volume of target constituents of less than 0.5 gallons. Soil from the underground storage tank area was found to contain halogenated volatile compounds, aromatic hydrocarbons and alcohols. The volume of soil within this area is estimated at 1,200 cubic yards although it is likely that only a portion of this volume contains target constituents. The total estimated volume of target constituents within this area is less than one gallon.

#### E.2.2 Groundwater

Three water-bearing zones have been identified beneath JASCO during the investigations conducted on-site. These three zones have been identified as the A-, B(1)-, and B(2)-aquifers. A deeper aquifer, the C-aquifer, occurs at a depth of approximately 150 feet below grade (94 feet below mean sea level) and supplies a portion of the area's public water. While the A- and B-level aquifer appear to be hydraulically connected, the C-aquifer is separated from the overlying aquifers in the Mountain View area by a 20- to 40-foot thick clay aquitard or a series of interbedded thinner aquitards. Groundwater flow is to the north-northeast at a gradient of approximately 0.004 ft/ft. The vadose zone lithology at the Site consists of interbedded clay, silt, sandy clay, and sandy silt.

Based on 1991 analyses, nine target constituents were present in A-aquifer groundwater samples. Six of these are halogenated volatile organic compounds (1,1,1-TCA, 1,1-DCA, 1,1-dichloroethane, chloroethane, methylene chloride, vinyl chloride). The remaining target constituents are petroleum hydrocarbons (both in the paint thinner and diesel fuel ranges) and acetone. The maximum concentrations of these nine constituents in samples collected in 1991 ranged from 0.0064 to 0.65 mg/l (approx. ppm). Target constituent presence is limited to the underground storage tank area, the former drainage swale area and areas immediately

downgradient of the drainage swale. Target constituent presence and concentration has decreased since the initiation of the groundwater extraction program.

Based on 1991 analysis of the groundwater, the target constituents within the B(1)-aquifer are limited to 1,1,1-TCA and 1,1-DCA at one location. The concentrations of these constituents are below the State Maximum Contaminant Levels (MCLs). Both the number and concentrations of target constituents have decreased over the past five years suggesting that no vertical migration of target constituents between the A- and B(1)-aquifers is occurring.

Neither the A- or B(1)-aquifer is currently being used or is likely to be used in the future as a drinking water source due to the regional presence of contaminants unrelated to the the presence of target constituents at the Site. A-aquifer groundwater as measured at a well at the Site in 1987 exceeded State and/or Federal secondary standards for total dissolved solids and several major anions and does not meet State criteria as a potential drinking water source. B-aquifer groundwater as analyzed at several sites in the vicinity of the Site was also found to be non-potable. At some locations B-aquifer groundwater was found to contain fecal coliform. In addition, the Santa Clara Valley Water District restricts the use of A- and B-aquifer groundwater to monitoring purposes due in part to concerns over salt water intrusion. Domestic or agriculture uses are prohibited. Vertical migration of target constituents from the A-aquifer to the C-aquifer at the Site is unlikely.

### E.3 BASELINE RISK ASSESSMENT

An Endangerment Assessment (EA) for JASCO Site was prepared by Jacobs Engineering Group Inc. (Jacobs), an EPA consultant, in August of 1989. Jacobs concluded that the Site does not pose a significant health risk under current land-use conditions. According to Jacobs, significant health risks under future land-use conditions would be limited to the use of A-aquifer groundwater as a drinking water source. Jacobs (1989) estimated that a maximum plausible excess cancer risk of  $4 \times 10^{-3}$  (4 in 1,000) for ingestion and  $6 \times 10^{-4}$  (6 in 10,000) for vapor inhalation would be associated with daily use of groundwater in the A-aquifer for domestic water supply over a lifetime (70 years). As the EA did not take into account the removal of constituent-laden soil from the drainage swale area in 1988, the decline in constituent presence and concentration between 1988 and 1991, or the unlikelihood that the A-aquifer groundwater could be used as a drinking water source, the risks presented in the EA may be greater than the actual risks.

### E.4 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

Potential ARARs for groundwater at the Jasco Site include contaminant-specific ARARs related to the use of groundwater resources for potable water supplies and action-specific ARARs related to the protection of aquifer resources and water treatment systems. The uppermost aquifer beneath the Jasco Site, is not currently used as a water source due largely to high levels of dissolved solids and concerns over salt water intrusion. The primary ARARs relating to groundwater quality are the Federal and State Primary and Secondary Drinking Water Standards. Two State resolutions adopted through the Porter Colognè Water Quality Control Act and administered through the Regional Water Quality Control Board are also applicable to the Site. These resolutions relate to the maintenance of existing water quality and the criteria used to determine whether an aquifer has a current or potential beneficial use.

Potential ARARs for air emissions at the Site are limited to the Federal Clean Air Act and National Primary and Secondary Ambient Air Standards, the State Air Resources Act and Air Toxics Hot Spots Information and Assessment Act and the Bay Area Management Pollution Control District Rules and Regulations.

No enforceable contaminant-specific standards for soil have been set for target constituents present at the Site. The State has developed criteria to define whether a material is hazardous based upon concentrations of contaminants in a waste. These concentrations are expressed as soluble threshold limit concentrations (STLC) and total threshold limit concentrations (TTLC). While these concentrations do not represent cleanup levels they are applicable to the Site with respect to the treatment and disposal of waste material.

## E.5 REMEDIAL ACTION OBJECTIVES

The remediation action objectives for the protection of human health and the environment at the site are: 1) the restoration of A-aquifer groundwater through the removal of target constituents in groundwater and soil; and 2) the lateral and vertical containment of the plume of target constituents in the A-aquifer. Obtaining these objectives will prevent the ingestion of water containing target constituents in excess of Maximum Contaminant Levels (MCLs) and will prevent a total cancer risk of greater than  $10^{-4}$  to  $10^{-6}$ . Central to these goals is the prevention of vertical migration of target constituents from vadose zone soil and A-aquifer groundwater to underlying drinking water sources (C-aquifer).

## E.6 GENERAL RESPONSE ACTIONS

General Response Actions were then developed for the two media of interest (i.e. soil and groundwater). Each action was evaluated with respect to its ability to achieve remedial action goals either as an separate action or in combination with other actions. The general screening actions that were evaluated for soil and groundwater included:

- o No Action
- o Institutional Actions
- o Collection
- o Containment
- o Diversion
- o Excavation
- o On-Site Treatment
- o In-Situ Treatment
- o On- and Off-Site Discharge
- o Relocation

Those general response actions which were not applicable to Site conditions or could not meet remedial action objectives were eliminated from further evaluation.

## E.7 IDENTIFICATION OF VOLUMES OF AFFECTED SOIL AND GROUNDWATER

The nature and extent of target constituents within the media of concern were evaluated with respect to remedial action objectives. To achieve remedial action goals for soil the presence of target constituents in soil within the former drainage swale and former diesel storage tank areas must be addressed. These areas contain approximately 1,140 cubic yards of soil which warrant remedial action. The presence of target constituents within the underground storage tank area will be addressed after the facility operations are ceased. The number and concentrations of target constituents within the underground storage tank area are significantly lower than in the former drainage swale area. The target constituents detected in soil within this area are similar to those found in the drainage swale and diesel storage tank areas. Technologies successful at remediating soil in those areas should be successful at remediating soil from the underground storage tank area.

To achieve remedial action goals for groundwater, both A-aquifer groundwater quality and the potential for vertical and lateral migration of target constituents within A-aquifer groundwater must be addressed. B-aquifer groundwater quality will not be addressed because no MCLs are exceeded and, as with the A-aquifer, its use as a drinking water source is unlikely.

## E.7 INITIAL SCREENING, ELIMINATION AND SELECTION OF TECHNOLOGIES

Remedial technologies within each response action and process options associated with a given technology were identified and evaluated for technical implementability. Those technologies or process options which could not effectively be implemented were eliminated from further consideration. The remaining process options were evaluated for their effectiveness, implementability, and cost. One process, if possible, was chosen to represent each technology.

For groundwater, the applicable process options selected for each technology are as follows:

<u>Remedial Technology</u>	<u>Process Option</u>
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Groundwater Monitoring
Extraction	Groundwater Extraction
Off-Site Discharge	Publicly Owned Treatment Works (POTW) Discharge
On-Site Treatment:	
Biological Treatment	Anaerobic/Aerobic
Physical Treatment	Carbon Adsorption
Physical Treatment	Air Stripping
Chemical Treatment	Ultraviolet Peroxidation
In Situ Treatment:	
Biological Treatment	Anaerobic/Aerobic

For soil, the applicable process options selected for each technology are as follows:

<u>Remedial Technology</u>	<u>Process Option</u>
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Vadose Monitoring
Extraction	Vapor Extraction
Excavation	Excavation of areas known to contain target constituents
On-Site Treatment:	
Biological Treatment	Enhanced Aerobic Treatment and X-19
Biological Treatment	Anaerobic Treatment
Soil Washing	Excalibur Treatment
In Situ Treatment:	
Biological Treatment	Aerobic/Anaerobic
Off-Site Discharge	RCRA Facility

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## E.8 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives were developed by combining applicable general response action and process options. A number of alternatives were assembled using different combinations of technologies applied to the different media and areas of concern. These alternatives were assembled to provide a range of appropriate alternatives which address the nine evaluation criteria with respect to remedial action objectives.

The remedial alternatives developed for groundwater and the process options contained in each are:

### Groundwater Remedial Alternative I: No Action

### Groundwater Remedial Alternative II: Discharge to POTW

- o Deed Restrictions
- o Extraction, Equalization and Mixing
- o Off-Site Discharge Under POTW Permit
- o Regular Groundwater and Discharge Monitoring

### Groundwater Remedial Alternative III: UV Oxidation

- o Deed Restrictions
- o Extraction
- o UV Oxidation
- o Polishing Treatment (optional)
- o Regular Groundwater and Discharge Monitoring
- o Off-Site Discharge Under POTW Permit

### Groundwater Remedial Alternative IV: Carbon Adsorption

- o Deed Restrictions
- o Extraction
- o Carbon Adsorption (liquid phase)
- o Regular Groundwater and Discharge Monitoring
- o Off-Site Discharge Under POTW Permit

### Groundwater Remedial Alternative V: Air Stripping

- o Deed Restrictions
- o Extraction
- o Air Stripping
- o Regular Groundwater and Discharge Monitoring
- o Off-Site Discharge Under POTW Permit

### Groundwater Remedial Alternative VI: Biological Treatment Followed by Carbon Adsorption

- o Deed Restrictions
- o Extraction
- o Ex-Situ Biological Treatment
- o Carbon Adsorption (liquid phase)
- o Regular Groundwater Monitoring
- o Off-Site Discharge Under POTW Permit

### Groundwater Remedial Alternative VII: In-Situ Bioremediation (to be provided as an addendum at a later date)

The remedial alternatives developed for soil, and the process options contained in each, are:

Soil Remedial Alternative I: No Action

Soil Remedial Alternative II: Off-Site Treatment

- o Deed Restrictions
- o Soil Excavation
- o Off-Site RCRA Treatment and/or Disposal

Soil Remedial Alternative III: Enhanced Biological Treatment

- o Deed Restrictions
- o Soil Excavation
- o Enhanced Biological Treatment
- o On-Site Replacement

Soil Remedial Alternative IV: X-19 Biological Treatment

- o Deed Restrictions
- o Soil Excavation
- o X-19 Treatment
- o On-Site Replacement

Soil Remedial Alternative V: Excalibur Process

- o Deed Restrictions
- o Soil Excavation
- o Soil Washing (Excalibur Process)
- o On-Site Replacement

Soil Remedial Alternative VI: In-Situ Bioremediation  
(to be provided as an addendum at a later date)

## E.9 COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the alternatives were then evaluated with respect to the nine evaluation criteria. The nine criteria as defined in the National Contingency Plan and CERCLA Section 121(b) and 121(c) are:

- o Overall Protection of Human Health and the Environment
- o Compliance with ARARs
- o Long-Term Effectiveness and Permanence
- o Short Term Effectiveness
- o Reduction of Contaminant Toxicity, Mobility or Volume
- o Implementability
- o State Acceptance/Support Agency Acceptance
- o Community Acceptance
- o Cost

The following is a summary of this analysis.

### E.9.1 Groundwater Alternatives

Overall Protectiveness. Alternative I: No Action would provide no additional protection of human health and the environment beyond the present local restrictions on use of A-aquifer groundwater. Expansion of the existing target constituent plume would occur under this alternative. Alternatives II to V would be protective of human health and the environment because each involves the extraction and treatment of constituent-laden groundwater and the containment of the present constituent plume. Alternatives II to V would equally mitigate significant risks to human health associated with the ingestion of A-aquifer groundwater and the inhalation of groundwater vapors.

Compliance With ARARs. Alternative I: No Action would not comply with ARARs as the groundwater would continue to contain target constituents at concentrations exceeding MCLs and the potential for migration of target constituents to potable drinking water sources would remain. Alternatives II to V are expected to provide compliance with ARARs. Alternative II: Discharge to POTW, which has been implemented at the Site since 1987, is expected to comply with the existing permit administered by the City of Mountain View based upon recent discharge data. Alternatives III to V will comply with the existing discharge permit because each would incorporate an on-site pretreatment step prior to discharge. The ability of Alternatives II to V to remediate groundwater to MCLs is dependent upon the implementation of soil remedial alternatives and the design of the extraction system. Alternatives II to V would be equally effective at meeting MCLs as each involves the extraction and treatment of constituent-laden groundwater.

Long-Term Effectiveness. Alternative I: No Action would be relatively ineffective at long-term reduction of the magnitude of residual risk. The target constituents present could degrade naturally under this alternative although there would be no engineering control of the process and the alternative would not be a reliable method of remediating groundwater. Alternatives II to V would be expected to provide effective long-term reduction of risks through the removal and treatment of affected groundwater and the containment of the constituent plume. Alternative II: Discharge to POTW is a reliable process that has been in use at the Site since 1987. Alternatives III to V are reliable processes based upon their application at other sites, however, their reliability under Site conditions would be dependent upon system design. The reliability of the carbon adsorption process utilized under Alternative IV (liquid phase) and potentially under Alternative V (air phase) is dependent in part on the interaction between the loading capacities of the target constituent suite. If implemented, each alternative should undergo a five-year review, both to determine the need for further remediation and to establish the effectiveness of the process.

Short-Term Effectiveness. There would be no significant risks to on-site workers during the implementation of Alternative I: No Action although the effectiveness at maintaining community protection would be dependent upon the local restrictions on A-aquifer groundwater use. The implementation protocol for Alternatives II to V would be protective of on-site workers and the community. The only potential environmental impact would be the continued drawdown on the A-aquifer required for groundwater containment. A ten-year action time has been estimated for all alternatives involving groundwater extraction although the actual action time required will be dependent upon the implementation of soil remediation alternatives and the variability of maximum sustainable pumping rates.

Reduction of Toxicity, Mobility and/or Volume. Alternative I: No Action would provide for no further reduction of the toxicity, mobility and/or volume of target constituents other than that which would occur through normal attenuation and would not satisfy the statutory preference for treatment. Alternatives II to V would provide a reduction of the total mass and volume of target constituents at the Site through the extraction of affected groundwater. Alternatives II to V would



also provide for the reduction of toxicity and mobility of target constituents through the treatment processes each will employ. Alternatives II to V involve a off-site treatment step at the POTW after discharge. All target constituents in extracted groundwater under alternatives III to V would be irreversibly destroyed either in the on-site treatment process (e.g. UV Oxidation) or during the regeneration of materials to which the contaminants were transferred on-site (e.g. carbon adsorption). The statutory preference for use of treatment technologies as opposed to removal and disposal technologies would be satisfied under alternatives III to V and may be satisfied under Alternative II depending upon the POTW process.

Implementability. Alternative I: No Action would involve no facility construction and would not affect the ability to implement further actions. Alternatives II to V would be relatively easy to construct and operate. Alternative V: Air Stripping could be more difficult to construct if it were to involve a holding tank and an automated system to hold, treat and discharge wastewater. Under the low flowrates that are expected, however, a flow-through system may be utilized which would be as easy to construct as the other alternatives. Alternative III: UV Oxidation would likely be the most difficult to operate due to the difficulties in fine-tuning the system to maintain optimal system performance. Alternatives II to V would not significantly affect the ease of adding additional treatment processes. Each of the alternatives utilize available technologies supplied by vendors that could provide the required equipment, materials and support.

State and Community Acceptance. Each of the alternatives would be feasible to implement from an administrative viewpoint. Alternative I: No Action would likely not be acceptable to the state or the community. Alternatives II to V would be expected to be acceptable to the community at their anticipated scope.

Cost. There would be no cost for the implementation of Alternative I: No Action. Of the remaining alternatives, Alternative II: Discharge to POTW would be the least costly to implement with a present worth of \$72,000. This alternative would involve a maximum capital cost of \$30,000 for the potential installation of additional extraction wells and approximately \$7,000 annually for monitoring and discharge costs. The most expensive alternative to implement would be Alternative III: UV Oxidation with a present worth of \$370,000. Capital costs would be approximately \$186,000 with an estimated annual cost of \$31,000. The present worth of Alternative IV: Carbon Adsorption is estimated at \$236,000. The present worth of Alternative V: Air Stripping is \$118,000. The need for treatment of air-effluent is not anticipated under Alternative V, however, if such treatment is necessary the present worth of this alternative would increase by between \$180,000 and \$200,000.

## E.9.2 Soil Remediation Alternatives

Overall Protectiveness. Alternative I: No Action would provide no additional protection of human health and the environment. Further migration of target constituents in soil could occur. Alternatives II and III would reduce risks to human health at the Site through the removal and treatment of affected soil. A treatability study would have to be conducted to determine the effectiveness of Alternatives IV and V at protecting human health. Alternatives II to V would be protective of the environment because each involves the removal of affected soil as well as measures to prevent further migration of target constituents in soil.

Compliance With ARARs. Alternative I: No Action would not comply with ARARs, as the affected soil would remain in place with no treatment. Alternative II: Off-Site Discharge would comply with ARARs. Alternative III: Enhanced Bio-treatment would be expected to comply with

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ARARs based on the biodegradability and volatility of the target constituents. The ability of alternatives IV and V to comply with ARARs would be determined during the treatability study.

Long-Term Effectiveness. Alternative I: No Action would be relatively ineffective at long-term reduction of the magnitude of residual risk. The risks associated with the migration of target constituents to groundwater would remain. The target constituents present could degrade naturally under this alternative. There would be no engineering control of the process and the alternative would not be a reliable method of remediating affected soil. Alternatives II to V would be expected to provide effective and permanent long-term reduction of residual risks through the removal of affected soil. Alternatives II, III and IV utilize reliable treatment methods and provide adequate controls. The Excalibur treatment process utilized under Alternative V is a recent development and its reliability is unknown. A five-year review would be required only for the No Action alternative. The treatment processes under alternatives II to V are not expected to take five years to complete.

Short-Term Effectiveness. There would be no significant risks to on-site workers under Alternative I: No Action. Dust control may be required during the excavation step of Alternatives II to V to protect against dermal contact and inhalation of dust containing target constituents. No short-term environmental impacts would be expected under alternatives II to V. Under Alternative II: Off-Site Treatment approximately six months would be required to complete the action. Under alternatives III to V, which involve on-site treatment, between one and two years would be required.

Reduction of Toxicity, Mobility and/or Volume. Alternative I: No Action would provide for no further reduction of the toxicity, mobility and/or volume of target constituents other than that which would occur through normal attenuation and would not satisfy the statutory preference for treatment. Alternatives II to V would provide a reduction of the total mass, volume and mobility of target constituents at the Site through the excavation, containment and treatment of affected soil. Target constituents in excavated soil under Alternative II: Off-Site Treatment would be irreversibly destroyed through off-site incineration. Under Alternative III: Enhanced Bio-treatment target constituents would be irreversibly destroyed either during biodegradation or during the regeneration of materials to which the contaminants were transferred on-site (e.g. carbon adsorption). Very low levels of organic constituents may remain in the excavated soil under Alternative III. A treatability study is recommended for Alternatives IV and V to determine their effectiveness at reducing the toxicity, mobility and volume of target constituents in soil. The statutory preference for treatment would be satisfied under alternatives II to V.

Implementability. Alternative I: No Action would involve no facility construction and would not affect the ability to implement further actions. Alternatives II to IV would be easy to construct and operate. The ease of constructing and operating Alternative V is unknown because the Excalibur Process was only recently developed. The incineration of affected soil under Alternative II may limit the application of additional actions. Alternatives III to V would not significantly affect the ease of adding additional treatment processes. Alternative II: Enhanced Bio-treatment utilizes available technologies supplied by multiple vendors that could provide the required equipment, materials and support. The number of incineration facilities that could handle Site wastes under Alternative II is limited and only one vendor exists for the X-19 and Excalibur processes under alternatives IV and V.

State and Community Acceptance. Each of the alternatives would be feasible to implement from an administrative viewpoint. Alternative III: Enhanced Bio-treatment would require an air emissions permit from the Bay Area Air Quality Management District. Alternative I: No Action would likely

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not be acceptable to the state or the community. Alternatives II to V would be expected to be acceptable to the community at their anticipated scope.

Cost. There would be no cost for the implementation of Alternative I: No Action. Each of the remaining alternatives include an estimated cost of \$200,000 for the excavation of affected soil. The most expensive alternative would be Alternative I: Off-Site Disposal with an estimated cost of \$1,683,000. Of the alternatives involving on-site treatment, Alternative IV: X-19 Treatment would be the least costly to implement with an estimated cost of between \$278,500 and \$318,500. The estimated cost for Alternative III: Enhanced Bio-treatment would range between \$365,000 and \$448,000 and the estimated cost for Alternative V: Excalibur Treatment would range between \$338,000 and \$470,000.

## 1.0 INTRODUCTION

### 1.1 PURPOSE AND ORGANIZATION OF REPORT

This Feasibility Study (FS) is being performed to develop remedial action alternatives for the Jasco Chemical Corporation (JASCO) Site. The FS provides the basis for selecting the most appropriate alternative to treat soil and groundwater containing target constituents at the Site. Results of the Remedial Investigation (RI) and the Endangerment Assessment (EA) conducted at JASCO have indicated there is a need for corrective action to mitigate the impacts of chemical compounds present at the site on the soil and groundwater. This FS has been prepared by O.H.M. Remediation Services Corp. (OHM) in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as revised by the Superfund Amendments and Reauthorization Act (SARA).

The purpose of the FS is to set remedial objectives that are protective of human health and the environment and to examine remedial technologies which satisfy these objectives. The technologies evaluated in this FS address the control and/or destruction of halogenated solvents and other organic constituents from the soil and groundwater, the reduction of the concentrations of the target constituents to acceptable levels and the prevention of exposure to these constituents. Available technologies are screened and those which are implementable are grouped into remedial action alternatives. The alternatives are examined in greater detail and assessed against the nine criteria set forth in the EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (1988).

### 1.2 BACKGROUND INFORMATION

#### 1.2.1 Site Description

The study area includes (1) the real property located at 1710 Villa Street, Mountain View, California, hereafter "JASCO", (2) the property which lies west of JASCO at a distance of approximately 150 feet and north of JASCO at a distance of approximately 275 feet. Figure 1.1 shows the location of the study area with respect to the City of Mountain View. Figure 1.2 shows the study area with respect to local roadways.

The area to the north and west of JASCO includes a portion owned by Southern Pacific Transportation Company (SP) and a portion of the Central Expressway, an east-west transportation corridor through the City of Mountain View as shown in Figure 1.2. The SP portion of the site consists of a 100-foot wide swath wherein two sets of railroad tracks extend in a general northwest-southeast direction connecting San Francisco with San Jose and points south. The Central Expressway, separated from the SP property by a six-foot high chain-link fence, is a four lane expressway with a 20-foot wide center median.

Figure 1.3 depicts the layout of the site and some of the general structures present. Structures include a chemical blending and packaging production area, a warehouse area for inventory, an underground storage tank area, and storage areas for new empty containers and drums.

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### 1.2.2 Site History

#### 1.2.2.1 Operations

JASCO took possession of the facility in 1976 and has operated the facility as a chemical blending and repackaging plant since this time. Previous to JASCO's operation the facility was operated by West Coast Doors, Inc. a manufacturer of residential and industrial doors. The site is surrounded to the south, west and east by multi-unit residential property and to the north by railroad tracks and property owned by SP.

The site was originally zoned for industrial use. In December of 1985, the Mountain View City Council adopted the Villa-Mariposa Precise Plan. The plan specified changes in land use within the area bounded by the SP railroad tracks, Villa Street, Shoreline Boulevard and the western boundary of the Site; this area includes the JASCO site. The plan dictated the transition of this area from industrial uses to primarily residential and research and development uses. According to this plan, JASCO will have to cease industrial operations by December of 1995.

#### 1.2.2.2 Regulatory History

In January of 1983 a resident of the area issued a complaint to the San Francisco Bay Regional Water Quality Control Board (RWQCB) concerning an alleged release of chemicals from the facility. JASCO, at the request of RWQCB, installed three monitor wells at the site between May of 1984 and November of 1986 and submitted results of the soil and groundwater investigations to RWQCB. The locations of the monitor wells are shown in Figure 1.4. On August 3, 1986, the RWQCB issued Cleanup and Abatement Order (CAO) No. 87-094 to Jasco, requiring remedial measures and the preparation of a remedial investigation /feasibility study. To comply with the order, JASCO conducted additional soil and groundwater investigations, installed ten new monitor wells (Figure 1.4), evaluated remedial alternatives, and implemented several interim soil and groundwater remedial measures. The RWQCB eventually referred the site to the EPA.

On June 24, 1988, EPA proposed the site for inclusion on the National Priorities List (NPL) under authority of the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The site was finalized on the NPL on October 4, 1989. The hazard ranking score was 35.56.

EPA issued Administrative Order (Docket No. 89-01) on December 21, 1988 which specified tasks to be completed by JASCO concerning the investigation and remediation of the Site. In compliance with this Order, JASCO has prepared and implemented the RI/FS and Sampling and Analysis Plan for the Site, completed additional soil and groundwater investigations including the installation of two additional monitor wells (Figure 1.4), and prepared a final Remedial Investigation Report.

#### 1.2.2.3 Interim Remedial Actions

A number of interim remedial actions have been performed on-site to reduce the concentrations of target constituents and to control the migration of target constituents in soil and groundwater.

Groundwater Extraction Program In April 1987, groundwater extraction began from monitor well V-4 and has been in continuous operation since this time. The extracted groundwater is discharged to the Mountain View sewer system under a permit from the city. The permit allows JASCO to discharge as long as the groundwater does not exceed 1 part per million (PPM) total toxic organic

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compounds (TTO as defined by 40 CFR 413.02) and does not exceed 0.75 ppm for any one constituent. The permit identified halogenated and aromatic volatile organics as the parameters of concern. Analyses of discharge samples for these constituents are conducted monthly to verify compliance to the permit. Discharge samples are analyzed using EPA methods 601 and 602 on a normal 14-day turnaround from sample collection to the completion of analyses.

The permit requires that JASCO cease discharging immediately if monthly sampling indicates that the discharge does not meet permit conditions. Under such circumstances, the groundwater is resampled and discharge is not continued until permit conditions are met. A more detailed description of the groundwater extraction program at well V-4 is included in the Remedial Investigation (OHM, 1991)

The radius of influence of pumping varies with pumping rate. At the maximum observed pumping rate of 2.2 gallons per minute (gpm) well V-4 is capable of containing all groundwater passing across the drainage swale and the northern property border of the Site (Appendix D). At the minimum observed pumping rate of 0.5 gpm, the well is capable of containing groundwater passing across the eastern portion of the drainage swale area which contains the highest concentrations of target constituents. The number and concentrations of target constituents present in groundwater has decreased since the initiation of groundwater extraction (see Section 1.2.5).

Drainage Swale Excavation Program Five hundred seventy-two cubic yards of soil were excavated from the drainage swale area in October and November, 1988. The area of excavation was centered around borehole locations from which soil analyses indicated the highest concentrations of target constituents. The excavation was extended to a depth of between 22 and 28 feet which was the approximate depth of groundwater at that time. The area was excavated by drilling with overlapping large diameter augers and backfilling each borehole with neat cement. The soil was disposed of at the Casmalia Resources Facility in Casmalia, California. A more detailed discussion of the Drainage Swale Excavation Program is included in the Remedial Investigation (OHM, 1991).

Surface Runoff Collection System Following excavation, a surface water runoff management system was installed to prevent further surface water infiltration across the drainage swale. This drainage system is currently in place. Downward percolation of surface water is prevented by a 10-mil thick polyethylene liner. Approximately six inches of fill was placed over the liner and graded to direct surface runoff to a sump which is used to pump the runoff to the sanitary sewer line. A system was also implemented in the front yard area to collect and direct surface runoff to the sanitary sewer system. In association with the implementation of this runoff collection system, three dry wells previously used for runoff collection were destroyed. A more detailed discussion of the Surface Water Runoff Collection System is included in the Remedial Investigation (OHM, 1991).

Underground Storage Tank Leak Detection System In March of 1988 a tracer leak detection system was installed at the underground storage tank system at the western edge of the Site. Tracer chemicals are periodically added to the tank contents. Soil-gas samples are collected monthly from multiple probes located to a depth of 12 feet both within and surrounding the tank farm. Each sample is analyzed for the tracer chemical to verify that no releases have occurred. A more detailed discussion of the Underground Storage Tank Leak Detection System is included in the Remedial Investigation (OHM, 1991).

Diesel Storage Tank Removal In October of 1987 an underground storage tank at the eastern edge of the Site was excavated and removed. JASCO made periodic use of the tank for diesel fuel

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storage; however, the tank was inactive at the time of removal. The soil overburden was first excavated by backhoe, then the tank was removed from the excavation. The tank was then thoroughly rinsed on-site and both the tank and rinsate water were transported and disposed off-site. The excavation was then filled with the soil overburden and with fill imported from the truck turn-around area on-site. A more detailed discussion of the tank removal program is included in the Remedial Investigation (OHM, 1991).

Destruction of Dry Wells In April of 1988, three dry wells in the front yard area of the Site were destroyed by redrilling with a large-diameter flight/bucket auger drill rig and pressure grouting with concrete. Drilling was ceased when native soil was reached indicating the bottom of the well. The soil and drain rock removed from the well locations were sampled, profiled and properly disposed at a Class III waste management facility. A more detailed discussion of these measures is included in the Remedial Investigation (OHM, 1991).

### 1.2.3 Nature and Extent of Target Constituents in Soil

The following is a description of the concentrations and distribution of target constituents within each potential source area. Additional information is available in the Remedial Investigation (OHM, 1991).

#### 1.2.3.1. Former Drainage Swale Area

The former drainage swale area has been divided into three areas: DS-1, DS-2 and DS-3 (see Figure 1.5). The vadose zone soil containing detectable concentrations of target constituents is within Areas DS-1 and DS-2. Area DS-3 has been excavated in 1988 in association with the Drainage Swale Excavation Program. For this reason, no further soil remediation within area DS-3 is warranted. The distribution of target constituents within areas DS-1, DS-2, and DS-3 is illustrated in figures 1.6, 1.7, and 1.8.

Area DS-1 is bounded to the north by the ballast of the railroad tracks, to the south by the concrete pad, to the west by borehole SB-5, and to the east by a point approximately 15 feet east of and excludes Area DS-3 which was previously excavated. Target constituents were detected from the ground surface to the top of groundwater within this area. Table 1.1 lists the target constituents which were detected in soil samples collected from this area and the maximum concentrations at which they were detected. Samples collected from the surface to the depth of groundwater at boring C-4 just east of this area (Figure 1.6) did not contain detectable target constituents. The combined surface area of areas DS-1 and DS-3 is approximately 1140 ft<sup>2</sup> (19 feet wide by 60 feet long). The surface area of area DS-3 is estimated at 460 ft<sup>2</sup>. The estimated area of DS-1 is equal to the difference of these two areas or 680 ft<sup>2</sup>. At present the depth to groundwater is 30 feet. Therefore, the total volume of soil within area DS-1 is estimated at 20,400 ft<sup>3</sup> or 755 yd<sup>3</sup> (680 ft<sup>2</sup> X 30 feet).

Area DS-2 encompasses the remainder of the drainage swale stretching 160 feet to the west of area DS-1. The presence of target constituents in this area, with a few exceptions, is limited to a depth of three feet. Table 1.2 lists the target constituents detected in soil samples collected from within this area and the maximum concentrations at which they were detected. Most maximum concentrations were noted in samples collected at a depth of three feet from locations approximately 30 feet east of the interim soil excavation area. The surface area of area DS-2 is approximately 3,040 ft<sup>2</sup> (19 feet wide by 160 feet long). At a depth of three feet the volume of soil within this area is estimated at 9,120 ft<sup>3</sup> or 340 yd<sup>3</sup> (3,040 ft<sup>2</sup> X 3 feet).

Halogenated volatile organic constituents and petroleum hydrocarbons were detected in all but one of the sample locations within area DS-1. In area DS-2, however, they are generally limited to the southeastern portion, less than ten feet north of the block wall and near to area DS-3.

The lateral distribution of acetone and alcohols extends across the entire length of areas DS-1 and DS-2 (approximately 200 feet). However, the highest concentrations are centered around boreholes SB-9 and SB-10. The lateral distribution of toluene, xylene and ethylbenzene extends across the length of areas DS-1 and DS-2 (approximately 200 feet). In the former drainage swale area benzene was detected only in the near-surface sample from boreholes S-1 and S-2. The presence of benzene at these locations may be unrelated to the activity at the site, as benzene is not used by JASCO in its production operations. Another potential source for the presence of this constituent in the near-surface soil is vehicle traffic from the Central Expressway. Benzene, as well as toluene, xylene, and ethylbenzene, is a common additive to gasoline fuel. A background surface soil sample collected from a point to the north of the SP rail lines (S-6, Figure 1.5) contained ethylbenzene, toluene and xylene at concentrations consistent with those detected in near surface soil from areas DS-1 and DS-2.

Table 1.3 lists the calculated average concentrations and estimated quantities of target constituents within the former drainage swale area, not including DS-3. The average concentration was calculated by dividing the sum of the results of laboratory analyses of all soil samples collected and dividing this number by the total number of samples. These calculations are based upon an estimated 1100 cubic yards of soil within areas DS-1 and DS-2. The estimated quantity of chlorinated compounds in 1100 cubic yards of soil is approximately 0.72 gallons or slightly less than three quarts.

The soil remediation alternatives evaluated in the FS will address the soil within both areas DS-1 and DS-2. The total volume of soil within these two areas is estimated at 1,100 cubic yards.

#### 1.2.3.2 Underground Storage Tank Area

The presence of target constituents in soil in the vicinity of the underground storage tank area is limited to methylene chloride, 1,2-dichloroethane, methanol, acetone, isopropanol and toluene at detectable concentrations ranging from 0.010 mg/kg to 5.8 mg/kg. Concentrations of target constituents present appear to be highest at the northwestern portion of the tank area. At the western boundary of the tank area methylene chloride was detected between the depths of one foot and 20 feet in June of 1987. In November of 1986, acetone, methanol and isopropanol were detected at the northern portion of the tank area between the depths of five and 36 feet. Toluene and 1,2-DCE were detected in samples collected from the eastern portion of the tank area at depths between 20 and 30 feet but the concentrations only slightly exceeded the minimum detection limit of 0.005 mg/kg. The distribution of target constituents within the underground storage tank area is presented in Figure 1.9. The average concentrations of target constituents present in this area are listed in Table 1.4.

The total amount of target constituents estimated to be present at average concentrations is also presented in Table 1.4. The dimensions of the underground storage tank area are approximately 50 feet long by 40 feet wide by 20 feet deep resulting in a volume of approximately 1,480 cubic yards. The total capacity of the existing tank farm is 55,000 gallons or 270 cubic yards. The volume of soil within the tank farm is the difference between the two or approximately 1,200 cubic yards. Because of the limited extent and low concentrations of target constituents in the soil within the underground storage tank area, the volume of soil warranting remediation may be considerably



less than 1,200 cubic yards. The estimated total weight of chlorinated compounds in this area is 1.0 pounds or 0.75 pints based upon a total volume of 1,200 cubic yards. The total estimated quantity of all target constituents detected in this area is approximately 0.9 gallons.

Local, state and federal tank closure and hazardous waste regulations will govern the treatment of contaminated soil excavated during tank closure operations. The soil remediation alternatives evaluated in this FS will not address the soil volume within the underground storage tank area because: 1) the extent of target constituent presence is limited; 2) the tank system is currently in use; and 3) a leak detection system capable of detecting leaks in the parts per billion range is in place at the tank area. However, because of the similarities in the constituents the technologies found to be feasible for remediation of drainage swale soil may also be applicable to the underground tank area soil.

#### 1.2.3.3 Former Diesel Fuel Tank Area

Analyses of soil samples collected from the excavation at the time of tank removal indicated the presence of total petroleum hydrocarbons as diesel fuel at concentrations between 59 and 360 mg/kg. Benzene, toluene and xylene concentrations ranged from 0.39 to 9.6 mg/kg. Soil samples collected between the surface and the depth of groundwater at downgradient borehole B-7 did not contain detectable concentrations of the constituents, indicating a lack of downgradient migration of these constituents. Methylene chloride was detected in one sample collected at a depth of one foot from this borehole, which is above the level of the former storage tank. The presence of methylene chloride is not likely to be associated with the former storage diesel tank operations.

The distribution of target constituents within the former Underground Diesel Tank Area is presented in Figure 1.10. The average concentrations of target constituents present in this area are listed in Table 1.5. The total amount of target constituents estimated to be present at average concentrations is also presented in Table 1.5. The excavation of the former diesel storage tank encompassed an irregular area equivalent to approximately 100 square feet. The depth of the excavation was approximately 10 feet. The total volume of soil within the former diesel storage tank excavation is 1000 cubic feet or 37 cubic yards. The estimated quantity of all target constituents detected in this area is slightly less than 0.5 gallons.

The soil remediation alternatives evaluated in the FS will address the soil within the former diesel storage tank excavation. The total volume of soil within this area is estimated at 37 cubic yards.

#### 1.2.3.4 Drum Storage Area

The presence of target constituents in soil at the eastern edge of the drum storage area as indicated by samples collected in July, 1990 is limited to benzene, toluene, ethylbenzene and xylene at depths of less than ten feet. Methylene chloride and 1,1,1-TCA had been detected in samples collected from the depths of one foot and 20 feet in June, 1987; however, 1,1,1-TCA was also detected in samples collected from the depths of three and 20 feet at a background location upgradient of the drum storage area. The presence of 1,1,1-TCA in background samples at similar concentrations and depths as that of the drum storage area samples suggests that the drum storage area is not the source for these constituents. Because of the limited extent and low concentrations of target constituents, remediation of soil within the drum storage area is not warranted. The distribution of target constituents within the drum storage area is presented in Figure 1.11.

#### 1.2.3.5 Background Locations

Soil samples collected from the surface and a depth of one foot at a location to the north of the SP railroad tracks contained detectable concentrations of toluene, xylene, ethylbenzene and methanol. This background data indicates the regional presence of these constituents. This regional contamination has likely contributed to the presence of toluene, xylene, ethylbenzene, and methanol in borehole samples collected within the former drainage swale area. These purgeable aromatic constituents (benzene, toluene, xylene and ethylbenzene) are common components of automobile fuel and the area is used heavily by automobiles and diesel-powered trucks from the Central Expressway.

A near surface soil sample collected from a background location to the south of the drum storage area contained high boiling point hydrocarbons at a detectable concentration consistent with the presence of diesel fuel. Diesel-powered delivery trucks use the area regularly. No target constituents were detected in soil samples collected from deeper depths at this location.

TCA was also detected in the background location south of the drum storage area. This area has never been used in the production operations on-site. The source of TCA in this area may be from surface spillage from adjacent areas or from an upgradient source. It is not likely the drum storage area is the source of TCA, since the drum storage area is downgradient.

#### 1.2.4 Nature and Extent of Target Constituents in Surface Waters

Surface water runoff from property neighboring JASCO is directed to storm sewer lines which discharge to Permanente Creek, located 600 feet west of the site. The storm sewer system, however, does not service JASCO directly. Surface runoff from the front yard area of JASCO flows to the north or northeast and collects near the production building. Surface runoff from the rear yard area collects in the drainage swale area. JASCO has installed a runoff management system at the site which directs all on-site runoff to several concrete sumps. Runoff is then pumped from the sumps to storage tanks on-site before being discharged to the sanitary sewer system through above-ground piping. Groundwater being extracted from well V-4 is being discharged, via above-ground pipes, to the city sewage system and at no time is present as surface water.

Permanente Creek, a concrete-lined engineered drainage channel, is the nearest body of surface water. No other surface water bodies are located within one mile of JASCO. It is not likely runoff from the site has affected bodies of surface water in the area. The remediation of surface water is not applicable to the JASCO site because no surface water bodies are present at the site and on-site runoff is collected and discharged to the sanitary sewer system.

#### 1.2.5 Nature and Extent of Target Constituents in Groundwater

Three water-bearing zones have been identified beneath JASCO during the investigations conducted on-site. These three zones have been identified as the A-, B(1)-, and B(2)-aquifers. Another aquifer, the C-aquifer, exists beneath the site. This aquifer, a source of drinking water, is at a depth of approximately 150 feet below grade (94 feet below mean sea level). The vadose zone lithology below the site consists of interbedded clay, silt, sandy clay, and sandy silt.

The A-aquifer, encountered at a depth of approximately 30 to 32 feet (28 feet above mean sea level), is of variable thickness. The A-aquifer is thickest in the vicinity of monitor well I-2 (14.7 feet) and thinnest in the vicinity of monitor well I-3. It is identified at well I-3 only by a soil color

change and increase in sand content. The lithology of the A-aquifer is predominantly interbedded sand, gravel, and clay.

The direction of groundwater flow in the A-aquifer as recorded in October of 1987 was 30 degrees east of north (N30E; see Figure 1.12) with a gradient of 0.004 ft/ft (0.004 vertical feet per each linear foot in the direction of groundwater flow). Groundwater flow within the A-aquifer has been affected by the extraction of groundwater from monitor well V-4. Pumping from monitor V-4 has caused the A-aquifer groundwater flow near the well to be deflected towards it. Downgradient of monitor well V-4, A-aquifer groundwater flow appears to be directed along a northeast trending line centered in the vicinity of monitor well V-7. The aquitard separating the A-aquifer and the B(1)-aquifer ranges in thickness from 6.5 feet at well I-1 to 17 feet at well I-2.

The thickness of the B(1)-aquifer ranges from 7.5 feet at well I-2 to 11.2 feet at well I-1. The lithology of this aquifer consists predominantly of silty and gravelly sand. The direction of groundwater flow within the aquifer as of August, 1987 was 15 degrees east of north at a gradient of 0.003 vertical feet per linear feet. The aquitard between the B(1) and B(2)-aquifers was penetrated approximately five feet during installation of the B(1)-aquifer wells. The aquitard contains an abundance of coarse sediments. It is only one foot thick at well I-3. The B(2)-aquifer was apparently penetrated at monitor well I-3. It is 58 feet below grade (one foot below mean sea level). No wells at the site are screened within this aquifer.

There is limited information about the lithology of the soils beneath the B-level aquifers since borings were not taken below the depth of the B-level aquifers. According to a study performed by Harding Lawson and Associates at a group of sites located approximately 1.5 miles east of JASCO, the C-aquifer is generally separated from the overlying B-aquifer by a 20-40 foot thick clay layer or by a series of thinner clay layers (HLA, 1987). The aquitard is laterally continuous and consists of stiff silty clay with lenses of sand. The top of the C-aquifer is located at a depth of 150 feet (94 feet below mean sea level).

#### 1.2.5.1 Target Constituents within the A-Aquifer

Groundwater samples from the A-aquifer are collected quarterly and analyzed for target constituents. The following target constituents have been detected in groundwater collected from the A-aquifer monitor wells over the past four sampling events conducted in 1991:

##### Halogenated Volatile Organics

1,1,1-TCA  
1,1-DCA  
1,1-DCE  
Chloroethane  
Methylene Chloride  
Vinyl Chloride

##### Non-Halogenated Organics

Acetone  
TPH as diesel  
TPH as paint thinner

The maximum concentrations of these nine constituents in samples collected in 1991 ranged from 0.0064 to 0.65 mg/l. Table 1.6 shows the variation of the maximum concentrations of target constituents in groundwater samples and the frequency at which these constituents were detected since monitoring was initiated in 1984. These data show a marked decrease in target constituent presence and concentration since the groundwater extraction program at well V-4 was initiated. Prior to 1989, 27 constituents were detected in groundwater samples at maximum concentrations ranging from 0.0026 mg/l to 142 mg/l. Table 1.7 shows the frequency of detection of target constituents in groundwater samples collected at each of the A-aquifer wells between 1984 and

1991. Table 1.8 shows the same data for the B(1)-aquifer wells. A more detailed summary of all groundwater analysis since 1984 is presented in Appendix A, Summary of Groundwater Analytical Results. These data are results of analyses of representative groundwater samples collected during previous hydrogeologic investigations or as part of the quarterly groundwater monitoring program. In addition, JASCO's Publicly-Owned Treatment Works (POTW) discharge permit require monthly analysis of discharge wastewater from monitor well V-4. The analytical results for discharge wastewater samples collected during 1990 are listed in Table 1.9.

The distribution of halogenated volatile organic constituents is generally limited to the area near and downgradient of the eastern portion of the former drainage swale area. Of the halogenated volatile organic constituents detected in monitor wells V-1, V-3, and V-4, only 1,1,1-TCA, 1,1-DCA and 1,1-DCE are currently present at detectable concentrations in downgradient monitor wells. The presence of chloroethane and vinyl chloride in A-aquifer groundwater is limited to monitor well V-4 at the eastern portion of the former drainage swale area. The presence of methylene chloride is limited to monitor wells V-1 and V-3 north of the underground storage tank area and well V-4. The distribution of 1,1,1-TCA, 1,1-DCA, and 1,1-DCE is limited to monitor wells V-1, V-3 and V-4 and several downgradient monitor wells.

The only additional target constituents currently present in A-aquifer groundwater are high boiling point hydrocarbons (present in monitor wells V-1, V-3 and V-4). The occurrence of high boiling point hydrocarbons in wells V-1, V-3 and V-4 has been persistent but in decreasing concentrations over past sampling periods. Since they have not been identified in downgradient wells, this suggests that lateral migration is minimal.

The general chemistry was analyzed for a sample collected from well V-3 in May of 1987. These analyses indicated that the A-aquifer groundwater contained total dissolved solids (TDS) and specific conductance at concentrations of 3,100 mg/l and 3,800 umhos/cm, respectively. The pH was neutral. Hardness was measured at 1,900 mg/l. The concentrations of copper, iron, manganese and zinc were 0.02 mg/l, 0.56 mg/l, 4.5 mg/l and < 0.05 mg/l, respectively. The concentrations of chloride and sulfate were 540 mg/l and 230 mg/l, respectively. Color was measured at 30 color units and the odor threshold number was 6.0. Turbidity was measured at 130 NTU.

#### 1.2.5.2 Target Constituents within the B(1)-Aquifer

The B(1)-aquifer monitor well network consists of three wells, I-1, I-2 and I-3 (see Figure 1.4). I-1 is constructed in the former drainage swale area. I-2 and I-3 are constructed downgradient of the site. Groundwater from these wells is collected and analyzed quarterly. Based on 1991 analysis of the groundwater, the target constituents within the B(1)-aquifer are limited to 1,1,1-TCA and 1,1-DCA in well I-2. The highest concentrations of 1,1,1-TCA and 1,1-DCA were 3.1 and 2.7 parts per billion (ppb), respectively. These concentrations are below the California Maximum Contaminant Levels (MCLs) of 200 and 5 ppb, respectively. No target constituents have been detected in I-1 or I-3 samples collected in 1990 or 1991 with the exception of phenol, which was detected in a I-3 sample collected in July, 1990, but has not been detected since that time. Table 1.6 summarizes the changes in target constituent presence in B(1)-aquifer wells since 1987. Both the number and concentrations of target constituents have decreased over this period of time. These data suggest that there is no vertical migration of target constituents between the A- and B(1)-aquifers at the Site.

The B(1)-aquifer is not currently being used as a source of drinking water nor is it likely to be used in the future. A study of the potability of B(1)-aquifer groundwater was conducted at the

Middlefield-Ellis-Whisman site (located 1.5 miles east of JASCO) in 1987 (Harding Lawson Associates, 1987). Nearly half of the B(1)-aquifer wells within this study area contained groundwater that exceeded at least one of the established drinking water standards for major anions and many of the wells also contained detectable amounts of fecal coliform (HLA, 1987). Nor is it likely that target constituent could migrate to the C-aquifer. As discussed earlier, the C-aquifer is separated from the B-aquifers in the Mountain View area by a continuous 20- to 30-foot clay layer or a series of interbedded clay layers (HLA, 1987). No target constituents have been detected in B(1)-aquifer wells at the Site at levels exceeding the maximum contaminant level. In order for Site conditions to affect the quality of groundwater in the C-aquifer, target constituents would have to migrate vertically from the A-aquifer through two B-level aquifers and through three aquitards separating the various A, B, and C-level aquifers.

Remediation of the B(1)-aquifer will not be addressed in the FS since: 1) the concentrations detected within the B(1)-aquifer are below the MCLs; 2) the presence of target constituents in the B(1)-aquifer is limited to 1,1,1-TCA and 1,1-DCA in one location; 3) the B(1)-aquifer is not currently used as a source of drinking water; 4) groundwater from numerous B(1)-aquifer wells within a two mile radius of JASCO has been found to be non-potable due to conditions unrelated to the presence of target constituents at the Site; and 5) a continuous 20- to 40-foot thick clay aquitard separates the B-aquifers from the C-aquifer which provides a portion of the local water supply. Monitoring of the B(1)-aquifer will continue for a period of time to assure the concentrations remain below the MCLs.

#### 1.2.6 Target Constituents Fate and Transport

##### 1.2.6.1 Migration of Target Constituents

Four potential pathways for the migration of target constituents from the site have been identified: vadose zone soil, groundwater, man-made potential conduits and surface and air dispersal.

Migration of target constituents through vadose zone soil at the site has occurred in several areas due to downward migration by gravity of precipitation and surface runoff through vadose zone soil containing target constituents. The presence of root casts and sandy interbeds provide a potential pathway for the vertical migration of target constituents to the A-aquifer. Lateral migration of target constituents in the vadose zone soil has occurred within the continuous coarse sand interbed about 15 feet below grade and along other discontinuous sandy interbeds. In the former drainage swale area and in on-site areas, downward percolation of precipitation and runoff is prevented by the runoff collection system which directs runoff to the local sanitary sewer system thereby minimizing target constituent migration through the vadose zone soil.

Downgradient migration of dissolved halogenated volatile organic constituents in a northerly direction has occurred within the A-aquifer. The stability of the concentrations of target constituents in downgradient monitor wells V-7, V-8 and V-9 suggest that the rate of migration is slow. Migration of target constituents from the drainage swale area appears to be limited to the more mobile chlorinated hydrocarbons such as 1,1,1-TCA, 1,1-DCA, 1,1-DCE and acetone. Less mobile target constituents such as alcohols and petroleum hydrocarbon mixtures have not been detected in monitor wells downgradient from the former drainage swale and underground storage tank areas.

Vertical migration of target constituents between aquifers appears to have occurred as evidenced by the presence of target constituents in groundwater collected from monitor wells completed in the B(1)-aquifer. The presence of these constituents may not be attributed to downward migration

through the aquitard separating the A- and B(1)-aquifers as target constituents may have been introduced into the B(1)-aquifer during construction of the B(1) wells. The greatest concentrations of target constituents from monitor well I-1 and I-2 were found immediately after the construction of the wells (August and September, 1987). Concentrations have decreased since this time. No target constituents have been detected in groundwater samples from monitor well I-1 since August, 1987. Concentrations in monitor well I-2 initially decreased and have since stabilized. The absence of target constituents in groundwater samples collected from I-1, less than five lateral feet from extraction well V-4, indicates that there is no vertical migration of contaminants from the A- to B(1)-aquifers in the drainage swale area.

Migration through the aquitard separating the two aquifers is unlikely. A sample of the aquitard collected from a depth of 36 feet from monitor well I-2 was classified as clay (CL) with a vertical permeability of  $3.1 \times 10^{-7}$  cm/sec ( $6.1 \times 10^{-7}$  ft/min). A sample collected from a depth of 28 feet at monitor well I-3 was also classified as clay (CL) with a vertical permeability of  $2.8 \times 10^{-6}$  cm/sec ( $5.5 \times 10^{-6}$  ft/min). Permeability values between  $10^{-8}$  and  $10^{-5}$  ft/min are considered to be low. The lateral continuity of this aquitard both on-site and at downgradient locations was established during the installation of the B(1)-aquifer wells. Lateral movement of target constituents within this aquifer would occur as a slow downgradient (northerly) migration. The presence of target constituents in B(1)-aquifer monitor wells over the past four monitoring phases is limited to 1,1,1-TCA and 1,1-DCA at monitor well I-2. This suggests that there is no downgradient migration of target constituents from potential source areas.

The low permeability of the aquitard underlying the B(1)-aquifer makes vertical migration to underlying aquifers unlikely. Laboratory testing of samples collected from the aquitard indicated the permeability of the aquitard to be  $2.9 \times 10^{-7}$  cm/sec ( $5.7 \times 10^{-7}$  ft/min) to  $2.3 \times 10^{-8}$  cm/sec ( $4.5 \times 10^{-8}$  ft/min).

Lateral and vertical migration of target constituents may have occurred in the past along surface pathways, particularly in the area of the former drainage swale. However, such pathways have been eliminated or significantly decreased. Migration of target constituents along these pathways are unlikely.

The migration of target constituents through air pathways would also be unlikely. Most target constituents are present at depths in excess of two feet, or are relatively immobile due to surface conditions or chemical characteristics.

#### 1.2.6.2 Target Constituent Persistence

The target constituents present at the site can be divided into three categories: halogenated volatile organic constituents, non-halogenated organic constituents and phenolic compounds. The volatile organic constituents identified at the site are generally highly volatile and moderately to highly soluble. These constituents would not be expected to be persistent in near surface soils. At depth and in groundwater they would be more persistent due to their solubility in groundwater, the vadose zone moisture, and their resistance to biodegradation by naturally occurring soil organisms.

The phenolic compounds identified in soil and groundwater at the site tend to be of low to medium solubility and low volatility. These constituents would tend to be very persistent in subsurface soil and groundwater. Their presence at the JASCO site is very limited and at very low concentrations.

The shorter chain petroleum hydrocarbons, which generally include thinners and gasoline, tend to be moderately to highly volatile with low solubility. They are readily biodegradable by naturally

occurring soil organisms under aerobic conditions. For these reasons, such constituents would not be highly persistent at shallow soil depths. They would be more persistent in groundwater, as they have a tendency to remain as free product floating on the groundwater surface (no groundwater samples from JASCO has had floating free product).

The longer chain petroleum hydrocarbons (predominantly diesel fuels) are less volatile. They are not as readily biodegradable so tend to be very persistent in subsurface soil and groundwater.

#### 1.2.7 Beneficial Uses of Resources

The current and potential beneficial uses of resources at or near the JASCO Site are limited to land-related and groundwater development uses. There are no surface water or wetlands uses for the JASCO Site.

##### 1.2.7.1 Land-Related Uses

The JASCO Site is currently zoned and operated for light industrial use. The property is bordered to the west, south, and east by land currently used for multi-unit residences. The property is bordered to the north by the Southern Pacific Railway right-of-way and currently used for passenger and freight transport. Within a 1,000 foot radius of the JASCO facility, the land is currently utilized predominantly for single and multi-unit residences. To the east of the Site, a portion of the land north of Villa Street is used for light industry and offices. To the west at the intersection of Escuela and Crisanto Avenues exists several light industrial properties including an operating dry cleaning establishment.

The JASCO Site falls within the jurisdiction of the Villa-Mariposa Area Precise Plan adopted by the Mountain View City Council on December 13, 1985. This plan provides for the transition of the area to primarily residential uses. Limited office/industrial uses will be allowed to continue to the east of the JASCO Site.

##### 1.2.7.2 Groundwater Uses

Three groundwater aquifers are present beneath the site at a depth of less than 200 feet. Present and potential uses for these aquifers include municipal, industrial, and agricultural uses.

The uppermost aquifer, designated as the A-aquifer, occurs at a depth of approximately 30 feet at the Site (28 feet above mean sea level) and varies greatly in thickness to a maximum of 15 feet. The B-aquifer is found at a depth of approximately 47 feet (11 feet above mean sea level). At the Site, this aquifer appears to be represented by two interconnected aquifers which extend to a depth of near 75 feet (approximately 17 feet below mean sea level). The top of the C-aquifer is encountered at a depth of approximately 150 feet (94 feet below mean sea level).

A-Aquifer. The potential for the use of A-aquifer groundwater for water supply is limited by yield and water quality. The yield of the aquifer is highly dependent upon groundwater levels, aquifer lithology and well placement. Two of the monitor wells at the site (V-9 and V-10) are nearly dry due to the decrease in the water table elevation over the past four years. In addition, several other A-aquifer monitor wells at the Site are routinely and rapidly purged to nearly dry by bailing during the groundwater sampling phases. The maximum estimated yield, based on pumping data from well V-4 is 3170 gallons per day (2.2 gal/min) although it has yielded at little as 720 gallons per day (0.5 gal/min). At present the yield of this well is between 1440 and 1728 gallons per day (1.0 to 1.2 gal/min).

The total dissolved solids (TDS) in the A-aquifer, as measured in a sample collected from well V-3 in May of 1987 was 3,100 mg/l. This is greater than the 500 mg/l Secondary Maximum Containment Level as defined by the National Secondary Drinking Water Regulations (40 CFR 413.3) and the 1,000 mg/l Secondary Drinking Water Standards as set by California Department of Health Services (Title 22, CCR, Sect. 64473). This also exceeds the 3,000 mg/l level used by the State of California to define suitable or potentially suitable water resources (State Water Resources Control Board, Resolution No. 88-63). While the federal government has defined potential drinking water sources in several regulations and guidance documents, these definitions are not directly applicable to Site groundwater. Under the Federal Underground Injection Control (UIC) Program Regulations (40 CFR 146.3) groundwater containing as much as 10,000 ppm TDS may be considered an underground source of drinking water. A more detailed definition of potential sources of drinking water is given in EPA's "Guidelines for Ground Water Classification under the EPA Ground Water Protection Strategy (1986)." Under this guidance document, a potential source of drinking water must also be able to be used without treatment or must be able to be treated using methods reasonably employed in a public water system in addition to meeting the 10,000 mg/l limit for TDS. Analyses for chloride, color units, manganese, odor threshold, and turbidity in the sample from well V-3 also exceeded Federal and state secondary drinking water standards. Fecal coliform bacteria were detected in this sample as well. Because the Site is located in an area prone to salt-water intrusion, it is likely that development of A-aquifer groundwater could result in an increase in the total dissolved solids within the aquifer.

The A-aquifer in the immediate vicinity of the JASCO Site does not represent a current or potential beneficial use as a drinking water source as defined by the State Water Resources Control Board Resolution No. 88-63 due to the levels of total dissolved solids and because the aquifer could not be utilized as a drinking water source without treatment or with methods reasonably employed in a public water system.

B-Aquifer. As with the A-aquifer, the B-aquifer is limited as a potential drinking water source by water quality. No general chemistry analyses were conducted on B-aquifer groundwater at the site; however, data is available from the B-aquifer at several sites located within a two mile radius of JASCO. The majority of B-aquifer wells sampled at the "Mountain View 5" study area (Harding Lawson Associates, 1987) and at the Teledyne/Spectra Physics study area (Levine-Fricke, 1986) exceeded established drinking water standards for at least one major ion. Many of the samples contained detectable amounts of fecal coliform. Based on these data it is unlikely that B-aquifer groundwater could be considered a current or potential drinking water source.

C-Aquifer. The C-aquifer is currently used to supply a portion of the potable water provided to Bay Area users. This aquifer represents both a current and potential beneficial use as a potable water source.

#### 1.2.8 Baseline Risk Assessment

An Endangerment Assessment for JASCO site was prepared by Jacobs Engineering Group Inc., an EPA consultant, in August of 1989 (see Appendix B, Jacobs Endangerment Assessment). This report did not take into account the removal of soil with high concentrations of target constituents from Area DS-3 in 1988.



The conclusions of the Jacobs (1989) EA are that the site does not pose a significant health risk under current land-use conditions. The only current exposure route was determined to be the inhalation of volatile compounds and the potential cancer risk was determined to be less than  $10^{-6}$ . Risks associated with exposure to contaminated soil by ingestion of surface soil or inhalation of fugitive dust were not significant. Under future land-use conditions, the site could pose a significant risk via ingestion and inhalation of volatile compounds in groundwater used for domestic purposes. Jacobs (1989) estimated that a maximum plausible excess cancer risk of  $4 \times 10^{-3}$  for ingestion and  $6 \times 10^{-4}$  for vapor inhalation would be associated with use of groundwater in the A-aquifer for domestic water supply. For carcinogens, a significant risk is considered to be an increased risk of developing cancer of greater than  $1 \times 10^{-6}$  as a result of lifetime exposure. Use of groundwater for domestic purposes would also pose significant non-carcinogenic risks.

OHM has reviewed the Jacobs (1989) Endangerment Assessment and generally concurs with the conclusions of the report; however, changes in site conditions since the EA was conducted may have reduced the risks calculated by Jacobs. The EA did not take into account the removal of soil with high concentrations of target constituents in 1988 or the unsuitability of A- and B(1)-aquifer groundwater for drinking water purposes. The drainage swale excavation program conducted in 1988 has significantly reduced the quantity of soil containing target constituents. The extraction program at well V-4, which has been in operation since 1987, has reduced the number and concentrations of target constituents in A-aquifer groundwater and limited the migration of the target constituent plume both laterally and vertically.

The EA concluded that, while there are no significant risks under current land-use conditions, future domestic use of downgradient A-aquifer groundwater could pose a health risk. This potential scenario is unlikely, however, because the A-aquifer does not appear to meet the State's criteria as a potential drinking water source. Total dissolved solids and several other constituents related to regional hydrologic conditions have been detected in groundwater from the Site at concentrations exceeding State and Federal Secondary Drinking Water Standards. Salt water intrusion is a problem throughout the South Bay area and has forced local agencies to restrict use of the A-aquifer. The Santa Clara Valley Water District Ordinance (SCVWD) No. 85-1, Section 7, allows only monitor wells to be installed in the A-aquifer. SCVWD also requires potable water wells be constructed with a minimum 50-foot sanitary seal. This would preclude the use of the A- and B(1)-aquifer groundwater as drinking water.

#### 1.2.9 Applicable or Relevant and Appropriate Requirements (ARARs)

Applicable requirements have been defined as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (EPA, 1988). Relevant and appropriate requirements, while not applicable, "address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (EPA, 1988).

The determination and evaluation of potential ARARs has been an ongoing activity in the RI/FS process for the Jasco Site. Table 1.10 presents all potential ARARs for the Jasco Site as evaluated by EPA. Included in this table is a determination of whether the statute or regulation is applicable to the Site, relevant and appropriate for the Site, or both.

There are three types of ARARs. Contaminant-specific ARARs address the presence of individual constituents of groups of specific constituents in the media of concern. Most commonly these ARARs are represented as water quality standards or permissible contaminant levels. Action-specific ARARs are standards that are focused upon the types of activities being conducted. Among the most common of these ARARs are regulations setting standards for waste treatment technologies or procedures for the disposal of wastes. The third type of ARARs are location-specific. These ARARs are usually associated with the protection of historic or biologically sensitive areas through the restriction of activities in these areas. The following is a discussion of potential ARARs with a comparison of the ARAR to existing Site conditions. The discussion will be divided by the medium of concern (i.e. soil, groundwater, air). Both contaminant- and action-specific ARARs will be discussed. No location-specific ARARs have been identified for the JASCO Site.

#### 1.2.9.1 ARARs for Groundwater

Potential ARARs for groundwater at the Jasco Site include contaminant-specific ARARs related to the use of groundwater resources for potable water supplies and action-specific ARARs related to the protection of aquifer resources and water treatment systems.

Federal ARARs that have been evaluated include the National Primary and Secondary Drinking Water Standards and Maximum Contaminant Level Goals. The Primary Drinking Water Standards are enforceable Maximum Contaminant Levels for current or potential drinking water sources and are applicable to the Site. The Maximum Contaminant Level Goals are non-enforceable standards that EPA has used under CERCLA in cases where cleanup levels more stringent than MCLs are necessary. For this reason, they are relevant and appropriate but are not applicable to the Site. Maximum Contaminant Level Goals are not enforceable but may be used as guidance during the establishment of cleanup levels. Table 1.11 summarizes established standards for constituents identified in groundwater and/or soil at the Site.

Chemical-specific State ARARs included the California Safe Drinking Water Act and Water Quality Objectives as defined by the Regional Water Quality Control Board. The Safe Drinking Water Act sets Primary and Secondary Maximum Contaminant Levels for Primary Drinking Water Sources. These standards are appropriate and relevant but not applicable to the Site. Table 1.11 summarizes established standards for constituents identified in groundwater and/or soil at the Site. Two State resolutions adopted through the Porter Cologne Water Quality Control Act and administered through the Regional Water Quality Control Board are applicable to the Site. State Resolution 68-16 requires the maintenance of existing water quality unless the change would benefit the public or would not result in an unreasonable effect on current or potential uses or the ability to meet other State policies. State Resolution 88-63 sets criteria to determine whether an aquifer has a current or potential beneficial use.

Additional Federal ARARs that relate to groundwater conditions at the Site are the National Pollutant Discharge Elimination System (NPDES) and the National Pretreatment Standards. These ARARs provide standards for the administration of programs to control pollutants entering water bodies or publicly-owned treatment works and are largely action-specific. Both potential ARARs are applicable to the JASCO Site. Several potential State ARARs may also be pertinent to the Site. These include the Porter-Cologne Water Quality Control Act which provides the mechanism for the development and enforcement of State water quality standards.

Nine target constituents were detected in A-aquifer groundwater during the sampling phases conducted in 1991 at the Site. Of these constituents, four have established State and/or Federal

Standards. During the most recent sampling phase in November of 1991, groundwater collected from three well locations exceeded the State Drinking Water Standard for 1,1-DCA and groundwater collected from one well location exceeded the State and Federal Drinking Water Standard for 1,1-DCE. None of the groundwater samples exceeded Federal and/or State standards for 1,1,1-TCA or vinyl chloride.

#### 1.2.9.2 ARARs for Air

Potential ARARs for air emissions at the Site are limited to the Federal Clean Air Act and National Primary and Secondary Ambient Air Standard, the State Air Resources Act and Air Toxics Hot Spots Information and Assessment Act and the Bay Area Management Pollution Control District Rules and Regulations.

The National Primary and Secondary Ambient Air Standards are contaminant-specific standards for the protection of public health and welfare. While not applicable, they are relevant and appropriate for alternatives that may result in the emission of regulated pollutants. The State ARARs relating to air emissions are administered through the Regional Air Pollution Control District. These are action-specific ARARs applicable to Site alternatives that may result in the emission of regulation pollutants such as air stripping and vapor extraction.

#### 1.2.9.3 ARARs for Soil

No enforceable contaminant-specific standards for soil have been set for target constituents present at the Site. The State has developed criteria to define whether a material is hazardous based upon concentrations of contaminants in a waste. These concentrations are expressed as soluble threshold limit concentrations (STLC) and total threshold limit concentrations (TTLC). While these concentrations do not represent cleanup levels, they are applicable to the Site with respect to the treatment and disposal of waste material. STLCs and TTLCs have been established for only two of the target constituents at the Site. The STLC and TTLC for trichloroethylene are 204 mg/l and 2040 mg/kg, respectively and the TTLC for vinyl chloride is 10 mg/kg.

## 2.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

### 2.1 INTRODUCTION

This initial screening step consists of identifying remedial technology types and selecting the most appropriate process option within each remedial technology type for detailed evaluation. Appropriate process options must satisfy the remedial objectives and be technically implementable. The remedial objectives are based upon information from the Endangerment Assessment.

After the range of appropriate process options has been identified, one option, if possible, is selected for each technology type. This selection is based upon effectiveness, implementability, and cost. More than one option may be selected if they are sufficiently different in their performance that one would not adequately represent the other, or if two options appear to meet the criteria for selection. These options are developed into remedial alternatives.

A detailed analysis of the selected alternatives is performed to evaluate each alternative against the nine criteria specified by EPA and to provide relevant information to aid decision-makers in their selection of a site remedy. These nine criteria are:

- 1) Overall protection of human health and the environment;
- 2) Compliance with ARARs;
- 3) Long-term effectiveness and permanence;
- 4) Reduction of toxicity, mobility, and/or volume of target constituents;
- 5) Short-term effectiveness;
- 6) Implementability;
- 7) Cost;
- 8) State acceptance; and
- 9) Community acceptance.

### 2.2 REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives for the Site must address the contaminants of concern, the exposure routes and the potential receptors. Potential risks to human health and the environment were calculated by Jacobs Engineering Inc. (Jacobs), in the Endangerment Assessment for the Site (Appendix B). Jacobs concluded that the only significant risks posed by the Site were related to the ingestion of A-aquifer groundwater and the inhalation of groundwater vapors. No significant carcinogenic or non-carcinogenic risks were calculated for the incidental ingestion of soil or the inhalation of fugitive dust. Jacobs defined significant carcinogenic risk as one that would result in a potential excess cancer rate to a population to be one in a million ( $1 \times 10^{-6}$ ). Although no risks were calculated for exposures to soil containing target constituents, the remedial action objectives will address the presence of constituents in soil because of the potential for further degradation of groundwater quality.

Jacobs concluded that future risks could result from the use of A-aquifer groundwater as a drinking water source. The A-aquifer, however, does not appear to meet the State's criteria as a drinking water source. A sample collected from A-aquifer well V-3 in 1987 exceeded the 3,000 mg/l limit for total dissolved solids (TDS) used by the State of California to define a potential drinking water source (State Resolution 88-63). Federal and State secondary drinking water standards for TDS, chloride, color units, manganese, odor threshold, and turbidity were also exceeded. Based upon these data, the A-aquifer does not meet State drinking water standards due to the presence of

constituents unrelated to the Site and could not be used as a drinking water source without substantial treatment. In addition, the local regional water district restricts the use of A- and B-aquifer groundwater in order to prevent subsidence and to limit the potential for saltwater intrusion.

The B-aquifer, which underlies the A-aquifer, is also not believed to be a potable water source based upon data collected at other sites in the Mountain View area (see Section 1.2.7). Target constituents have been detected in B(1)-aquifer groundwater at the Site but current levels are below the maximum contaminant levels. The C-aquifer, encountered at a depth of approximately 150 feet in the Mountain View area, is a potable water source that provides a portion of the water supply to the Southern San Francisco Bay Area.

The remediation action objectives for the protection of human health and the environment are: 1) the restoration of A-aquifer groundwater; and 2) the vertical and lateral containment of the plume of target constituents in the A-aquifer. Central to these goals is the prevention of vertical migration of target constituents from vadose zone soil and A-aquifer groundwater to the underlying drinking water sources (C-aquifer). Obtaining these objectives will prevent the ingestion of water containing target constituents in excess of Maximum Contaminant Levels (MCLs) and will prevent a total cancer risk of greater than  $10^{-4}$  to  $10^{-6}$ . The following is a discussion of remedial action objectives as they relate to the media and constituent of concern.

### 2.2.1 Soil

Jacobs (1989) modelled the migration of chemicals at the JASCO site using a one-dimensional analytical model to evaluate the downward leaching of chemicals from vadose zone soils into the A-aquifer and a numerical model (SUTRA) to model the downgradient migration of chemicals within the aquifer. Based on the modelling effort in the Endangerment Assessment, a ratio between the concentrations in downgradient groundwater was determined. The groundwater concentrations of target constituents have decreased since the Endangerment Assessment was conducted.

OHM used the soil concentration to groundwater concentration ratio or dilution factor, together with allowable groundwater concentrations (MCLs, listed in Table 1.9 or health risk-based values) to determine allowable concentrations of site chemicals in soil. These soil remediation goals are designed to adequately protect future on-site and nearby off-site residents from any potential health effects associated with the migration of chemicals into groundwater that could be used as a domestic water source. A more detailed discussion of the remediation level goals and the methods by which they were calculated are included in Appendix C. OHM identified ten key chemicals for assessing soil remedial actions goals at the Site:

Benzene	Tetrachloroethene
1,1-Dichloroethane	1,1,1-Trichloroethane
1,2-Dichloroethane	Trichloroethene
1,1-Dichloroethene	Vinyl Chloride
Methylene Chloride	Petroleum Hydrocarbons

This list includes all of the key constituents identified by Jacobs in the Endangerment Assessment with the exception of pentachlorophenol (PCP). PCP was eliminated from the list because it had not been identified in any of the soil samples collected after the EA had been conducted and has been detected in only two groundwater samples, the latest being in April of 1990. In addition, the concentrations at which PCP was detected in groundwater only slightly exceeded the detection limit. 1,1,1-Trichloroethane and petroleum hydrocarbons were added to the list by OHM because they have been detected at elevated concentrations in soil and groundwater samples at the Site. Of

the key constituents, all are considered possibly carcinogenic with the exception of 1,1,1-Trichloroethane and Petroleum Hydrocarbons.

The remedial action objectives for soil at the Site are to remediate soil containing key constituents to the levels as shown in Table 2.1. These goals were developed based on a comparison with cleanup criteria used at other sites and a consideration of site-specific factors, including the potential for migration and the small amount of material present.

The models used by Jacobs (1989) do not consider retardation or degradation. Volatile organic compounds (VOC) will not move at the same rate as water, but will be slowed somewhat by adsorption to soil particles. Some of the compounds are expected to become tightly bound to these particles or to become trapped in soil micropores. These compounds may not be readily desorbed back into the water column. Both biological and chemical degradation processes will act to break down some of the compounds. Studies at Moffett Field and elsewhere have indicated that some biodegradation of halogenated organic compounds is occurring. The occasional detection of vinyl chloride, a breakdown product of trichloroethylene and dichloroethylene, at the JASCO site may indicate that some degradation is occurring.

Only a small area of the Site contains chemicals, particularly following the excavation of the drainage swale area. Because the modelling effort assumed that a larger area of the Site contained target constituents, whereas a major portion of the soil containing target constituents has already been removed, the actual amount of dilution that would occur is likely to be greater than predicted by the Jacobs (1989) model. Furthermore, the modelling also assumed that the chemicals of concern were present in soils at a uniform concentration. Because the dilution factors used in this assessment were based on this assumption, chemicals present in soil at levels slightly above the soil remediation goals would probably not pose a health concern as long as the average concentration of the chemical in a particular area was below the criteria.

In summary, several factors suggest that the modelling conducted by Jacobs overestimated health risks and that the soil remediation goals are overly protective of human health:

- The models do not account for the likely retardation of organic chemicals as a result of adsorption by soil particles.
- The potential effect of either biological or chemical degradation are not considered in the model.
- The area of the former drainage swale containing the greatest quantity and highest concentrations of chemicals has been removed. Consequently, the majority of the potential source material has been removed.
- Because much of the source material has been removed, a greater amount of dilution may occur than the Jacobs (1989) modelling predicted.
- The Jacobs (1989) modelling effort assumed a uniform chemical concentration in soils across the Site. Dilution factors developed using this assumption are appropriate for determining an allowable average site concentrations.

### 2.2.2 Groundwater

OHM has identified five key constituents in groundwater based upon their persistence in groundwater analyses conducted in 1991 and evaluations of health-based risks: 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), methylene chloride, 1,1,1-trichloroethane (1,1,1-TCA) and vinyl chloride. Four other constituents were detected in groundwater samples collected in 1991. The presence of acetone and chloroethane in groundwater samples has been sporadic and/or generally limited in extent or concentration (see tables 1.7 and 1.8 and Appendix B). Petroleum hydrocarbons have been identified at three locations in 1991 at concentrations generally less than 0.5 mg/l. The cumulative results of past investigations as presented in the Remedial Investigation suggest that the potential source areas have been sufficiently identified. Implementation of a remedy to remediate source areas with respect to the key constituents will also result in a corresponding decrease in commingled constituents.

The remedial action objective for groundwater is the containment of the plume of key constituents in the A-aquifer to prevent the exposure to and ingestion of water containing key constituents in excess of Maximum Contaminant Levels (MCLs). Primarily, the objective is to prevent key constituents from migrating vertically from the A-aquifer to underlying potable water sources (C-aquifer). Secondary to this goal is the restoration of the A-aquifer groundwater to maximum contaminant levels (MCLs) as specified by the State of California and the Federal Safe Drinking Water Act. The MCLs for key constituents are shown in Table 2.2 along with the maximum concentrations in 1991 and the most recent concentration for each key constituent.

Despite the establishment of restoration of A-aquifer groundwater quality as a secondary remedial action goal, it has not been established whether existing groundwater treatment technologies are capable of achieving this goal. In an EPA study of 13 sites at which aquifer restoration was a remedial action objective at only one site was the remedial action successful (Pollution Engineering, November 1991, "Limitations of Pump and Treat Technology, pg. 64). At six of these sites the remedial action objective was modified from aquifer restoration to plume containment. The absence of target constituents at B(1)-aquifer well I-1, adjacent the A-aquifer well containing the greatest concentrations of constituents, suggests that the extraction system in place at well V-4 is effective at preventing vertical migration of contaminants and that plume containment is an achievable goal.

### 2.2.3 Comparison of On-Site Concentrations with Remediation Goals

#### 2.2.3.1 Soil

Results of analyses of soil samples collected from area DS-2 (Figure 1.7) indicate that most chemicals in these areas were present at levels below the soil remediation goals. Only two samples, both collected in May 1989 at a depth of three feet, contained chemicals at levels above these values. In both SB-9 and SB-10, methylene chloride, a possible carcinogenic VOC, was detected (6.2 and 6 mg/kg, respectively). In SB-9 the non-carcinogenic compounds acetone and isopropanol were detected at 49 mg/kg and 164 mg/kg, respectively. Acetone was detected at 100 mg/kg in SB-10. Considering the very dry conditions in the region since 1988, the actual concentrations of these chemicals still remaining at the Site are probably much lower as a result of volatilization. Even at the concentrations detected in 1988, the average concentrations of these chemicals in this area are well below the soil remediation criteria. In addition, isopropanol (rubbing alcohol) and acetone are much less toxic than 1,1,1-trichloroethane, the compound used as the basis for the soil remediation goals. Levels of these materials are somewhat above the soil remediation goals and are unlikely to pose a health risk. Based on a review of the data and a

consideration of the potential environmental behavior of these compounds, it seems unlikely that chemicals from the DS-2 area would pose a public health risk.

The northwest corner of the former drainage swale area (area DS-3, Figure 1.8) contained the greatest quantity and highest concentrations of chemicals. Remediation was performed in this area. Over 550 cubic yards of soil were removed and replaced with concrete to a depth of groundwater at approximately 25 feet. Consequently, this area (DS-3) has been removed as a potential source of chemicals to groundwater.

Analyses of samples collected from Area DS-1 (the former drainage swale area to the north and east of the interim soil excavation) indicated that some residual target constituents remain in this area (Figure 1.6). The material present at the highest concentrations were low-to-medium boiling point hydrocarbons. These compounds were detected in every sample from boring C-1. A maximum concentration of 6700 mg/kg was reported at five feet below the ground surface. Concentrations of 380 mg/kg and 38 mg/kg were reported at 25 feet and 30 feet below grade, respectively. Toluene and xylene were detected at 110 mg/kg and 37 mg/kg, respectively, from a depth of 5 feet. Concentrations were less than 10 mg/kg in the deeper samples. In boring C-2, low-to-medium boiling point hydrocarbons were reported at concentrations of 2800 mg/kg, 1300 mg/kg, and 2600 mg/kg, in samples collected from 15 feet, 20 feet, and 25 feet below grade, respectively. The low-to-medium boiling point hydrocarbons were not detected at other depths.

Concentrations of halogenated VOCs were generally low in area DS-1. Sampling locations SB-1 and SB-2 contained the possibly carcinogenic VOCs 1,1-DCA and methylene chloride with concentrations between 0.5 and 2 mg/kg. Boring C-2 contained low levels of these compounds; the highest concentration of methylene chloride was 0.71 mg/kg from 20 feet below grade. Boring C-1 contained 1,1-DCA, 1,1-DCE, methylene chloride, and tetrachloroethylene at concentrations above 1 mg/kg. 1,1-DCA (2.2 mg/kg), methylene chloride (3.2 mg/kg) and tetrachloroethylene (4 mg/kg) were all detected in boring C-1 at 25 feet below grade and 1,1-DCA was reported at 3 mg/kg at 30 feet below grade. The non-carcinogenic halogenated VOC, 1,1,1-TCA, was detected at 61 mg/kg at 5 feet but was present at less than 10 mg/kg at 15 and 20 feet and was not detected at greater depths in boring C-1.

The halogenated compounds present in Area DS-1 are at concentrations only slightly above the soil remediation goals. However, levels exceeding the soil remediation goals have been detected at, or just slightly above groundwater where further dilution, degradation, and attenuation would be limited. In addition, low-to-medium boiling point hydrocarbons are present at concentrations exceeding 1,000 mg/kg. These compounds may act to increase the desorption of other organic chemicals from soil particles.

#### 2.2.3.2 Groundwater

Maximum Contaminant Levels (MCLs) for three constituents (1,1-DCA, 1,1-DCE and vinyl chloride) and the proposed Maximum Contaminant Level for methylene chloride have been exceeded at the Site in groundwater samples collected in 1991. Appendix A shows the historic groundwater quality data for the Site. Based upon the most recent groundwater analyses in November of 1991, the concentration of 1,1-DCA at wells V-3, V-4 and V-7 exceeded the MCL and the concentration of 1,1-DCE and methylene chloride at well V-4 exceeded the MCL.

The concentration of 1,1-DCA at well V-1 has exceeded the MCL only three times since 1987 and most recently in July of 1990 and the concentration of 1,1-DCA at well V-3 has exceeded the MCL only once (November 1991) since December of 1989. The concentration of 1,1-DCA at wells V-4



and V-7 have consistently exceeded the MCL at well V-4. The MCL for 1,1-DCA has not been exceeded at any of the remaining A-aquifer wells at the Site.

The MCL for 1,1-DCE has been exceeded only once at well V-1 (January 1988) and only twice at well V-3 (September 1987, January 1988). The concentration of 1,1-DCE at well V-4 has consistently exceeded the MCL. The MCL for 1,1-DCE has been exceeded only once at well V-7 (January 1991) since March of 1988. The MCL for 1,1-DCE has not been exceeded at any of the the remaining A-aquifer wells.

The proposed MCL for methylene chloride has been exceeded in approximately half of the samples collected from well V-1. In 1991, the proposed MCL was exceeded in two of the four samples collected from this well but the maximum concentration was 0.0058 mg/l or only slightly greater than the proposed MCL of 0.005 mg/l. At well V-3, the proposed MCL for methylene chloride has not been exceeded since July of 1990 and has been exceeded in less than half of the samples collected since 1986. The proposed MCL for methylene chloride was exceeded at well V-4 during the previous two quarterly sampling phases but prior to this had not been exceeded since January of 1990. The proposed MCL for methylene chloride at well V-4 has been exceeded in approximately half of the samples collected since 1987. The only other A-aquifer well at which the proposed MCL for methylene chloride was exceeded was well V-10 and then only during one sampling phase (January 1989).

The MCL for vinyl chloride was exceeded only once in 1991 at well V-4 during the April sampling phase. Vinyl chloride has been detected in less than half of the groundwater samples collected at well V-4 since the initiation of groundwater monitoring (see tables 1.7 and 1.8). Vinyl chloride has not been detected in groundwater collected from wells V-3 and V-7 since January of 1988. Vinyl chloride has not been detected at any other of the remaining A-aquifer wells. The MCL for 1,1,1-TCA has not been exceeded at any well location since December of 1989.

## 2.3 GENERAL RESPONSE ACTIONS

To achieve the remedial action objectives required for JASCO, general response actions or conceptual remediation measures were developed in accordance with EPA guidelines for performance of feasibility studies under CERCLA. General response actions which may be pertinent for remediation of the groundwater and soil are presented in Table 2.3, General Response Actions for Groundwater and Soil.

## 2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

### 2.4.1 Initial Screening and Elimination of Technologies

Remedial technologies within each response action and process options associated with a given technology have been identified and evaluated. The remedial technologies and process options were initially evaluated for technical implementability. A process option may be considered not implementable if it cannot adequately treat the target constituents present or if it would be difficult to construct and maintain the process operation on-site. Those technologies or process options which cannot effectively be implemented have been eliminated from further consideration. The technologies and options which were evaluated are listed in Table 2.4 for groundwater and in Table 2.5 for soil.

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#### 2.4.1.1 Groundwater Remediation Options Eliminated from Evaluation

The following groundwater remediation options were eliminated from further consideration:

- Horizontal Barriers
- Alternate water supply
- Coagulation/Flocculation
- Filtration
- Reverse Osmosis
- Dechlorination
- Neutralization
- Solvent Extraction
- Injection wells.

**Horizontal barriers** are used to prevent the vertical migration of target constituents. The flow of leachate passing through soil containing target constituents is impeded by the installation of a horizontal barrier. A horizontal barrier does not prevent lateral migration nor does it reduce the concentration of target constituents. A horizontal barrier would not be effective at JASCO since the target constituents have already migrated to groundwater.

**Alternative water sources** are not applicable since the local population does not use the A-aquifer or B(1)-aquifer groundwater.

**Coagulation/flocculation** is a physical/chemical process in which fine particulate matter is conditioned for removal from a waste stream by addition of inorganic or organic chemicals. These induce and accelerate the aggregation of the particulates into larger, settleable particles. This is not applicable for JASCO since there are no suspended constituents.

**Filtration** is a physical process which separates particles suspended in a fluid by forcing the fluid through a porous medium. As the fluid passes through the medium, the suspended particles are trapped on the surface of the filter medium and/or within the voids of the medium. This is not applicable for JASCO since there are no suspended constituents.

**Reverse osmosis** is a membrane separation process which uses mechanical force (high pressure from 250 to 1500 psi) as the primary driving force for transport of solute (usually water) through a membrane, concentrating the dissolved components. Water passes through the membrane, while the dissolved matter is left behind. This is essentially a molecular sieve, separating water from dissolved matter. The ratio between the clean water passing through the membrane and the rejected dissolved matter depends on the initial concentration of dissolved matter in the waste stream. The higher the concentration, the higher the rejected fraction. The level of the initial concentration will also determine the type of membrane to be used. Periodic washing of the membrane is required. Reverse osmosis cannot be effectively implemented at JASCO because it is designed for chemical compounds with molecular weights greater than 100 grams per mole and the majority of the constituents present at JASCO do not meet this criteria.

**Chemical dechlorination** refers to a group of technologies which can be used to strip chlorine atoms from specific highly-chlorinated toxic compounds, such as PCBs and dioxins. Several commercial processes for treatment of transformer fluids are sodium-based, using proprietary solvents. Other processes which use a potassium compound in combination with other alkali metals in polyethylene glycol are in development. Dechlorination processes strip the chlorine from the organics to form an alkali metal salt and a substituted organic polymer. The majority of

constituents at JASCO are not highly-chlorinated and could not be successfully treated by these processes.

**Neutralization** is a chemical process consisting of adding an acid or an alkali to a waste stream in order to adjust its pH. Neutralization is not applicable since there is no pH problem.

**Solvent extraction** is a process in which selected constituents of a liquid solution are extracted by contacting it with another immiscible liquid, usually a solvent. The constituents to be removed must be more soluble in the extracting solvent than in the original solution. Solvent extraction would be difficult to implement at the Site because of the low concentration of constituents present in the groundwater. If the extracting solvent dissolves, even dilutely, in the groundwater, this process may actually increase the volume of contaminants in Site groundwater. It is also difficult to find a solvent which will satisfactorily extract all the constituents from water. As a result, a series of solvents would most likely be required, which would not be technically- or cost-effective.

**Injection wells** could be used to reinject treated groundwater back into the aquifer. Under favorable conditions, the reinjected water may act to flush contaminants from the soil and accelerate soil and groundwater remediation. The potential use of injection wells at the Site was eliminated because: 1) existing technologies may not be able to treat the extracted groundwater to acceptable levels prior to injection; 2) the limited extent of target constituents in soil would make it difficult to locate injection wells where they could aid in the flushing of contaminants in soil; 3) the placement of injection wells near the former drainage swale area would jeopardize the ability of the extraction system to prevent downgradient migration of groundwater containing target constituents; and 4) the costs involved in the installation of injection wells and acquiring a Waste Discharge/NPDES Permit through the Regional Water Quality Control Board may outweigh any savings gained through improved remedial action effectiveness.

#### 2.4.1.2 Soil Remediation Options Eliminated from Evaluation

The following soil remediation options were eliminated from further consideration:

- Dechlorination
- Neutralization
- Carbon Adsorption
- Resin Adsorption
- On-site Incineration.

**Dechlorination** and **neutralization** process options are not appropriate for the same reasons stated for the remediation of groundwater.

**Carbon adsorption** and **resin adsorption** cannot be applied directly to the soil. The target constituents must first be transferred to an aqueous or gaseous stream to use these processes. If either mass transfer processes can be successfully accomplished these options may be reconsidered. The transfer process would first require either soil washing or vapor extraction.

**On-site incineration** is the destruction of target constituents by exposing them to extremely high temperatures (in excess of 1000 °C). It is an effective process but would be impractical to implement because of the proximity to local housing and the concerns regarding community acceptance. This method would not be cost effective for the small amount of soil present at this site because the cost of an on-site incinerator for a small site is prohibitive.

## 2.4.2 Selection of Representative Process Options

The remaining process options were evaluated for their effectiveness, implementability, and cost. One process, if possible, has been chosen to represent each technology. Table 2.6 and Table 2.7 present a summary of the evaluation for groundwater and soil, respectively.

### 2.4.2.1 Applicable Remedial Process Options for Groundwater

For groundwater, the applicable process options selected for each technology are as follows:

<u>Remedial Technology</u>	<u>Process Option</u>
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Groundwater Monitoring
Extraction	Groundwater Extraction
Off-site Discharge	Publicly-Owned Treatment Works (POTW) Discharge
On-site Treatment:	
Biological Treatment	Anaerobic/Aerobic
Physical Treatment	Carbon Adsorption
Physical Treatment	Air Stripping
Chemical Treatment	Ultraviolet Peroxidation
In Situ Treatment:	
Biological Treatment	Anaerobic/Aerobic

#### No Action

The No Action option must be retained per the National Contingency Plan. No action would consist of shutting down the groundwater extraction and discharge, discontinuing the quarterly monitoring of monitor wells, and allowing the plume of target constituents to degrade naturally. Further migration of the plume would most likely occur. Local, state, and federal agencies do not consider this an acceptable option.

#### Deed Restrictions

Deed restrictions would limit the future use of groundwater at the site. Even without the deed restrictions, it is unlikely the groundwater in the A-aquifer will ever be used for potable water. The Santa Clara Valley Water District Ordinance (SCVWD) No. 85-1, Section 7, prohibits water supply wells to be installed in the A-aquifer, allowing only monitor wells. SCVWD also requires potable water wells be constructed with a minimum 50-foot sanitary seal. This would preclude the use of the A- and B(1) aquifer groundwater as drinking water.

#### Groundwater Monitoring

Groundwater monitoring includes groundwater level measurement, the collection of groundwater samples and analysis of the samples for a range of target constituents. Quarterly groundwater monitoring is currently conducted to characterize and monitor the quality of groundwater at JASCO.

### Groundwater Extraction

Groundwater extraction from the sub-surface reduces the amount of target constituents present within the aquifer and limits the extent of vertical and lateral migration by capturing groundwater. Groundwater extraction from the A-aquifer has been in operation since 1987. Once extracted, the water is discharged to the City of Mountain View's sewage treatment plant. If maximum sustainable pumping rates in the A-aquifer decrease, additional extraction wells may need to be installed to adequately capture groundwater flowing past the former drainage swale area and to treat the groundwater on a larger scale (see Appendix D, Groundwater Extraction System). Groundwater capture through the installation of additional wells would require that the aquifer yield is adequate and wells could be placed in feasible locations. A minimum of one extraction well and a maximum of three wells (at the minimum anticipated pumping rate of 0.5 gpm) would be required to capture A-aquifer groundwater in the direction of flow across the former drainage swale area. The basis for the extraction system is presented in Appendix D.

### Off-site Discharge: Publicly Owned Treatment Works (POTW)

JASCO has been discharging extracted groundwater to the City of Mountain View's sewage treatment facility since 1987. The water is treated at the Publicly Owned Treatment Works (POTW). This discharge is permitted by the City of Mountain View. The discharge is monitored monthly to ensure the concentrations do not exceed the levels set by the permit, which are less than 1 ppm total organics and less than 0.75 ppm for any one constituent as analyzed by EPA Method 601/602. In addition to treating groundwater this remedial technology also provides for the containment of the target constituent plume through the extraction of groundwater.

### Ex Situ and In Situ Biological Treatment

Biological treatment relies on natural or specialized bacteria to remove organic constituents from wastewater or soil. Provided the organic material is not toxic or refractory, and its concentration is not prohibitive to bacterial activity, bacteria can utilize the organic constituents as food. Certain biochemical reactions proceed in an aerobic environment (i.e., dissolved oxygen is present in the waste stream), others in an anaerobic environment (i.e., the waste stream is devoid of dissolved oxygen). Regardless of the treatment environment, the process involves two pathways. In one pathway, bacteria synthesize organic matter for their metabolism and propagation of the species. In the second pathway, bacteria oxidize organic matter to the end product: carbon dioxide and water in the case of aerobic treatment, carbon dioxide and methane in anaerobic systems. In doing so, they produce the energy they need to sustain metabolism.

Currently there are no commercially-demonstrated biological processes in use which will totally degrade TCA, TCE, PCE, and vinyl chloride, although there is considerable progress being made in laboratory and pilot-scale studies. Most of the other organic non-chlorinated constituents are known to be biodegradable. The bioremediation processes which exist degrade the above chlorinated components to DCA or DCE and then finally to vinyl chloride which may then be removed in a vapor phase. There are experimental processes which are being tested that may degrade these compounds further. These experimental processes utilize both aerobic and anaerobic treatment. JASCO may consider evaluating these processes at its site and, for this reason, both aerobic and anaerobic biotreatment have been retained for on-site technology consideration.

The ex situ and in situ bioremediation remedial technologies are both retained. Biological treatment can be performed either aerobically or anaerobically. Although soil conditions at JASCO (sand, clay, silt) may hinder in situ bioremediation, recent research performed at Stanford University

suggests that in situ bioremediation may be possible at sites such as JASCO. Based on this recent research, the in situ option has been retained for further evaluation.

### Carbon Adsorption

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Adsorption processes rely upon surface phenomenon and molecular diffusion. The surface phenomenon remove dissolved organics from aqueous waste, or organics from air streams, through surface attachment to granular material of suitable characteristics. The organics are also removed from the waste stream as the molecules diffuse into the pore spaces of the carbon. Adsorption takes place when organic molecules in the liquid (or gaseous) phase become attached to the surface of the granular material, as a result of the attractive forces at the granular surface (absorbent) overcoming the kinetic energy of the liquid (or gaseous) constituents (adsorbate) molecules.

Activated carbon, a porous material having a large surface area per unit volume and a non-polar surface, can adsorb most organic compounds to some degree, although carbon usage can be excessive for certain constituents (e.g., vinyl chloride). Greater than 99 per cent removal efficiency can be achieved for many organics. Exhausted carbon (i.e., carbon saturated with organics) is usually regenerated by thermal processes by the vendor off-site.

### Air Stripping

Stripping is a mass transfer process in which volatile constituents are transferred from an aqueous solution into the gaseous phase. The stripping medium can be air or steam.

Air stripping is a proven technology for the removal of volatile organics from water; the non-volatiles remain in the stripped groundwater. It is accomplished normally in a counterflow packed tower, with the aqueous solution flowing downward and the air blown upwards. It is sometimes accomplished in an aerated tank where air is bubbled through the water.

Carbon adsorption, or another capture or destruction technology, must be provided in conjunction with stripping. This is due to the Bay Area Air Quality Management District's (BAAQMD) emission control standards.

### Ultra Violet (UV) Oxidation

UV oxidation is a catalyzed oxidation process used to destroy organic compounds. Chemical oxidation of hydrocarbons produces carbon dioxide and water. Oxidation of halogenated hydrocarbons produces inorganic halides. In the process, an oxidant, usually hydrogen peroxide or ozone, is added to the wastestream. After the addition of the oxidant, the wastestream flows across UV lamps. The energy from the UV light catalyzes the chemical oxidation of the organic compounds. Many organic compounds absorb energy from UV light and may undergo a change in their chemical structure or become more reactive with chemical oxidants. This increase in reactivity enhances the oxidation process. This is an effective process for destroying many organic compounds, including chlorinated organics.

#### 2.4.2.2 Non-Applicable Remedial Process Options for Groundwater

Several groundwater remedial process options were deemed to be non-applicable for the target constituents at JASCO. A description of these processes and their faults are discussed further.

### Cap

A cap above soil containing target constituents would prevent surface water from leaching down through the soil resulting in vertical migration of target constituents. A cap could be considered as an interim action until remediation begins at the site but it would not resolve the long-term potential for environmental degradation. At present a soil runoff collection system is maintained in the former drainage swale area as an interim action. The cap consists of several layers of an impermeable membrane and overlying soil graded to direct runoff to a collected sump where it is pumped to the municipal sewer system.

### Vertical Barriers

This technology involves the construction of an impermeable vertical barrier to stop the lateral migration of target constituents. The barrier may be a slurry wall or a grout curtain.

A slurry wall is constructed by digging a trench to the depth of a confining layer and pouring a bentonite slurry mixture into the trench as it is being dug. The slurry mixture is added to prevent the trench from collapsing on itself and to prevent the intrusion of groundwater. Eventually the slurry mixture is replaced with a concrete mix which hardens in place.

A grout curtain is constructed by injecting grout under pressure into pre-drilled boreholes. The grout flows through the soil and eventually hardens. The soil must be coarse so that the grout can penetrate through it.

These barriers have limited effectiveness, are difficult to implement and are very expensive. The barriers are susceptible to cracking or erosion by corrosive leachate. A barrier constructed at JASCO would have to extend to 57 feet below the ground surface (depth to confining layer). The cost of slurry wall is \$3 to \$5 per square feet (depth by length). Grout curtains are up to 10 times as expensive. Barriers to isolate JASCO could range from hundreds of thousands to millions of dollars. The equipment necessary to implement these barriers is quite large and the presence of the railroad tracks could inhibit the placement of isolation barriers. It would very difficult to mobilize and stage this equipment in the limited space at JASCO and would not actively reduce the concentrations of target constituents.

### Resin Adsorption

Resin adsorption operates in the same manner carbon adsorption does. The difference is that resin adsorption uses synthetic adsorbents (resins). These resins are produced using high surface, porous polymers to suit specific applications. However, the commercial availability of specialty resins for adsorption of adsorbates of different chemical characteristics is quite limited. These resins are also more expensive than carbon. Since carbon is known to effectively adsorb most organics, it is currently the preferred method for treating water streams containing mixed organics.

### Steam Stripping

Steam stripping can be applied for organics of low to high volatility and/or of high concentration (1 to 20 per cent). This process is accomplished in a counterflow tower. The process creates a small stream of condensed steam and organics which require further treatment, usually by incineration. Steam stripping is more expensive than air stripping because it requires more energy than air stripping. This stripping method should not be necessary since the volatilities of the constituents at JASCO are high enough that air stripping will suffice in stripping them.

### Supercritical Oxidation

This is a process in which an aqueous waste stream is subjected to temperatures and pressures above the critical point of water (375 °C and 22 MPa) to oxidize organics. Under these conditions, oxygen is miscible with supercritical water and inorganics are practically insoluble. This allows the organics to be oxidized rapidly and the inorganics to be separated easily.

The process operates by feeding a pressurized waste solution into a reactor, along with air or oxygen. The combined fluid is elevated above the critical point, which causes rapid oxidation of the organics to CO<sub>2</sub>, N<sub>2</sub>, and CO. Halogens, phosphorous and sulfur are converted to weak acids. Inorganic salts are removed as a concentrated brine.

The cost to construct a facility for this process is extremely high. It is also not practical or implementable to build a long-term high-temperature, high-pressure process in a residential neighborhood.

### On-site Discharge: National Pollution Discharge Elimination System Permit

On-site discharge is defined as direct discharge to the storm sewer system or reinjection of treated groundwater. On-site discharge does not include discharges to the Publicly Owned Treatment Works (POTW) which are defined as off-site discharges. On-site discharge methods would require a NPDES permit. This permit would be obtained through the California Regional Water Quality Control Board. The permit would also require the monitoring of discharge to ensure that concentrations do not exceed allowable levels.

#### 2.4.2.3 Applicable Remedial Process Options for Soil

For soil, the applicable process options selected for each technology are as follows:

<u>Remedial Technology</u>	<u>Process Option</u>
No Action	None
Access Restrictions	Deed Restrictions
Monitoring	Vadose Monitoring
Extraction	Vapor Extraction
Excavation	Excavation of areas known to contain target constituents
On-site Treatment:	
Biological Treatment	Enhanced Aerobic Treatment and X-19
Biological Treatment	Anaerobic Treatment
Soil Washing	Excalibur Treatment
In Situ Treatment:	
Biological Treatment	Aerobic/Anaerobic
Off-site Discharge	RCRA Facility



### No Action

The No Action option must be retained per the National Contingency Plan. No action would consist of leaving all soils in place without the use of any means to prevent migration of target constituents.

### Deed Restrictions

Deed restrictions would limit the use of the land. The land will most likely become residential property. Strict restrictions may be implemented to limit exposure to soil containing target constituents if the soil is left on-site. Examples of such restrictions include prohibiting exposed soil and requiring a concreted or landscaped cover. Some restriction already exist at the Site. The former drainage swale area, where much of the target constituents in soil is located, is within the Southern Pacific (SP) railroad right-of-way, on which residential properties would not be allowed.

### Soil Monitoring

Soil samples will be collected and analyzed during excavation to characterize the extent of target constituents. When used in conjunction with a treatment process, sampling and analysis will also provide data regarding the progress of the treatment.

### Vapor Extraction

Vapor extraction uses the same principle as air stripping. It is a mass transfer process in which volatile constituents are transferred from the soil to a gaseous phase. The stripping medium, air, is drawn through the soil to volatilize the constituents and transfer them to the gaseous stream. This process can be performed in situ or ex-situ. If done in situ, vapor recovery wells are constructed and air is drawn through the wells. The decision to perform in situ or ex situ vapor extraction is based in part on the type and volume of soil encountered. If the soil is air-permeable (e.g. coarse sand), in situ vapor extraction is feasible. If the soil is not very air-permeable (e.g. clay) and a nominal volume of soil is involved, ex situ treatment is more effective.

Vapor extraction has been retained, but is not expected to be effective as an in situ process due to the clay and silt content of the soil at the Site. However, vapor extraction (in combination with bioremediation) could be very effective if the soil is mixed with a bulking agent and treated ex situ, as is the case for the Enhanced Biological Treatment option.

### Excavation

Soil known to have significant concentrations of target constituents are excavated and either treated on-site or taken to a TSD facility. Soil analysis is used to confirm that the appropriate soil is removed. The soil is treated or disposed of following excavation.

### Ex Situ and In Situ Biological Treatment

As with the groundwater, both aerobic and anaerobic options are retained for ex situ and in situ biological approaches so that emerging processes can be evaluated.

Enhanced bioremediation is used for soil which contains a combination of volatile and non-volatile hydrocarbons that are biodegradable. This system is totally enclosed to assure that no air emissions

occur during operation and to maintain a controlled environment for bioremediation. OHM uses an enclosed treatment system that includes a treatment vessel, air distribution system, and a vapor recovery system. The moist air passing through the soil in the vessel provides oxygen to the bacteria while simultaneously stripping the more volatile organics. The stripped air then passes through two carbon adsorption canisters that are in series. The air is monitored between and after the carbon canisters to determine when the carbon is exhausted and needs to be changed. Prior to treatment in the vessel, nutrients are added to the soil and it is pre-treated to assure adequate air distribution and biodegradation. Additional water and nutrients are added, as needed, during operation.

Another potential biological treatment method worth evaluating is a soil composting process using X-19, a proprietary soil additive that incorporates a specially-developed microbial consortium. X-19 is applied to the soil in combination with a bulking agent and the additives are thoroughly mixed into the soil. The developer of this technology claims that it is effective in biodegrading chlorinated hydrocarbons, such as TCE and TCA, to non-detectable levels. The vendor suggests that the X-19 be mixed into the target constituent containing soil along with the appropriate nutrients and water and that the entire soil pile be covered. Within several months, all of the organics supposedly will have been biodegraded and a rich soil amendment will result. Since this has not been effectively demonstrated (according to EPA protocol) for chlorinated hydrocarbons, a treatability (and possibly a pilot study) would have to be performed to properly evaluate X-19's effectiveness and overall feasibility for treating this mixed organic-containing soil.

In situ bioremediation has been retained based on recent research by Stanford University. Information concerning the research has not yet been reviewed by OHM. Information will be provided in an addendum to this document.

#### Excalibur Soil Washing/Catalytic Ozone Oxidation Process

The Excalibur process has been included because its inventors claim, and initial studies indicate, that it can very effectively remove mixed organic constituents from soil and destroy them using a specialized UV oxidation process. This patented process is being demonstrated through the SITE program. It is designed to treat soils that contain organic and inorganic constituents. The technology is a two-stage process; the first stage separates the target constituents from the soil; the second stage destroys the extracted constituents. The initial extraction step uses ultrapure water (prepared on-site by a patented process) and ultrasound to separate constituents from the soil. The second step uses ozone, ultraviolet (UV) light, and ultrasound simultaneously to oxidize the constituents. The treatment byproducts are decontaminated soil and salts. This technology is being demonstrated, under the EPA's SITE program, at a PCP-contaminated wood preserving facility. This technology has not been extensively demonstrated although initial treatability results have been very encouraging. Treatability studies would be required before this process could be seriously recommended for application at JASCO.

#### RCRA-Permitted Facility

Soil is excavated and transported off-site to a RCRA-permitted facility for treatment and disposal. Off-site disposal alone is not an option because the land-ban restrictions include some of the constituents present at JASCO. The soil would need to be pre-treated (e.g., incinerated) at a RCRA facility prior to disposal.

#### 2.4.2.4 Non-Applicable Remedial Process Options for Soil

Several soil remedial process options were deemed to be non-applicable for the target constituents at JASCO. A description of these processes and their faults are discussed further.

##### Cap

A cap would prevent surface migration of target constituent by isolating soil containing target constituents from surface runoff. It would also prevent surface water from percolating down through these soil and further transporting target constituents into the groundwater. A cap could be considered as an interim action until remediation begins at the Site but it would not resolve the long-term potential for environmental degradation. At present a soil runoff collection system is maintained in the former drainage swale area as an interim action. The cap consists of several layers of an impermeable membrane and overlying soil graded to direct runoff to a collected sump where it is pumped to the municipal sewer system under permit.

##### Clay or Synthetic Liner

Soil placed within a clay or synthetic (e.g. polymer plastic) liner is isolated from groundwater. This prevents both vertical and lateral migration of target constituents into the groundwater. The liner must be adequately engineered to ensure long-term integrity. This process would not actively reduce the number and concentrations of target constituents in soil at the Site. In addition, the presence of constituent-laden soil and the space requirements of the liner would likely present unacceptable restrictions to future land use at the Site.

##### Desorption

Heat is applied to soil to vaporize the target constituents. The vapor can either be discharged to the atmosphere or collected for further treatment. This process has been eliminated from further consideration because of the high energy requirements for a relatively small volume of soil and because it is not practical or publicly acceptable to operate a volatilizer in a residential community. Thermal treatment processes are comparatively more expensive than ex situ vapor extraction or enhanced bioremediation, which would be equally effective.

##### Heated Stripping

Heated stripping is a stripping process in which the stripping medium is heated. The medium can be steam or heated air. This process has been eliminated for the same reasons as the elimination of desorption. The energy and cost requirements would be high in comparison to other options.

##### In Situ Vitrification

In situ vitrification is a process in which the soil is heated to its melting point. The target constituents within the soil are either volatilized or thermally destroyed. Residual constituents are trapped within the matrix of the soil after it has cooled and hardened. The voids within the soil disappear and the soil experiences a loss of volume.

The technology heats the soil by means of electrodes placed around the area to be treated. A hood is placed over the area to capture off-gases. These off-gases are collected and treated.

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Vitrification does not appear to be implementable at JASCO. This is an expensive technology designed for larger sites where no other option is feasible. It is most appropriate for inorganic waste and mixed waste as organics vaporize out of the soil. The area to be treated is located near the Southern Pacific Railroad tracks. The melt would extend to the tracks and any volume loss of the soil would damage the structural integrity of the tracks. The vent hood, which is 50 feet by 50 feet, could not be extended over the active tracks.

The remaining options will now be organized into remedial alternatives that are evaluated in detail in Section 3.0.

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### 3.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives have been developed by combining the remaining remedial process options. These alternatives have been evaluated against the nine criteria specified by the EPA. This evaluation is summarized in Table 3.1 for groundwater alternatives and Table 3.2 for soil alternatives. These nine criteria are:

- 1) Overall Protection of Human Health and Environment;
- 2) Compliance with ARARs;
- 3) Long-term Effectiveness and Permanence;
- 4) Reductions in Toxicity, Mobility, and Volume through Treatment;
- 5) Short-term Effectiveness;
- 6) Implementability;
- 7) Cost;
- 8) State Acceptance; and
- 9) Community Acceptance.

Table 3.3 and Table 3.4 provides additional information regarding each groundwater and soil alternatives' compliance with ARARs, respectively.

The cost for the alternatives were based on vendor quotes and published information. Vendor quotes and cost calculations are provided in Appenidx E. These costs are believed to be within a range of +50% to -30%. The costs are compared independent of the other criteria in Table 3.5, Present Worth Costs of Remedial Alternatives.

#### 3.1 GROUNDWATER REMEDIAL ALTERNATIVES

The groundwater remedial alternatives have been developed and are given below. Each of these alternatives incorporates a series of remedial technologies which, in combination, address the above nine criteria.

##### Groundwater Remedial Alternative I: No Action

- No Action

##### Groundwater Remedial Alternative II: Discharge to POTW

- Deed Restrictions
- Extraction, equalization and mixing
- Off-site Discharge under POTW Permit
- Regular Groundwater and Discharge Monitoring

##### Groundwater Remedial Alternative III: UV Oxidation

- Deed Restrictions
- Extraction
- UV Oxidation
- Polishing Treatment (optional)
- Regular Groundwater and Discharge Monitoring
- Off-site Discharge under POTW Permit

#### Groundwater Remedial Alternative IV: Carbon Adsorption

- Deed Restrictions
- Extraction
- Carbon Adsorption (liquid phase)
- Regular Groundwater and Discharge Monitoring
- Off-site Discharge under POTW Permit

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#### Groundwater Remedial Alternative V: Air Stripping

- Deed Restrictions
- Extraction
- Air Stripping
- Regular Groundwater and Discharge Monitoring
- Off-site Discharge under POTW Permit

#### Groundwater Remedial Alternative VI: Biological Treatment followed by Carbon Adsorption

- Deed Restrictions
- Extraction
- Ex-situ Biological Treatment
- Carbon Adsorption (liquid phase)
- Off-site Discharge under POTW Permit
- Regular Groundwater Monitoring

#### Groundwater Remedial Alternative VII: In-Situ Bioremediation

- To be provided in an addendum at a later date.

The scoping and costing of Alternatives II through VI are based on a system consisting of three extraction wells, which is an approximation of the maximum number of wells that may be required to achieve remedial action goals. The three-well system is used here as a method for comparing groundwater remedial alternatives and does not necessarily represent the system configuration that would be utilized. The minimum extraction system will consist of one well located near the center of the present target constituent plume. The extraction system should be designed and maintained to reflect site hydrogeology at the time of extraction. Maximum sustainable pumping rates at the site have fluctuated significantly in response to changes in precipitation and recharge rates.

The scope of the system described in the FS is based in part on historic data from existing extraction well V-4 and on a model for determining the effective radius of single and multiple extraction well systems. The application of this model to site conditions is discussed in Appendix D. At the lowest recorded pumping rate of 0.5 gallons per minute (gpm), three wells located in the drainage swale area would be effective at containing and extracting the target constituent plume. At the highest recorded pumping rate of 2.2 gpm, pumping from only the existing extraction well V-4 would be more than sufficient for the same purpose. As of March of 1992, well V-4 has been extracting groundwater consistently at a rate of approximately 1.0 gpm over the preceding months. At this pumping rate, extraction well V-4 would be sufficient for containing and extracting the present target constituent plume.

The effectiveness of groundwater extraction and treatment technology is highly dependent upon site hydrogeology. Present and historic site data will be evaluated during the remedial design stage

to determine the most appropriate design. Variables include the number of wells, their placement, and the distances between wells. Too few extraction wells or multiple wells placed too far apart may not contain the entire plume or may result in the splitting of the plume into smaller plumes which are more difficult to recover. Too many extraction wells may result in the recovery of a large volume of uncontaminated groundwater from outside of the plume. This previously uncontaminated groundwater becomes contaminated by its contact with the plume and takes up available capacity in the treatment process. Extraction wells placed too close will cause interference between the radii of influence and may result in a decrease in the pumping efficiency.

The cost of installing an extraction well and tying it into an extraction system is estimated at \$10,000. The estimated cost of installing the three-well maximum system would be \$30,000 although the cost would be only \$20,000 if present extraction well V-4 could be incorporated into this system. There would be no installation costs for a one-well extraction system which utilizes existing extraction well V-4. For the sake of cost comparison, each groundwater extraction alternative will be based on a three-well system which does not utilize well V-4. The maximum flowrate from this system would be 6 gpm and the minimum would be 1.5 gpm. All treatment process equipment is based on the maximum flowrate of six gpm.

Due to the drought conditions, it may not be possible to effectively pump the A-aquifer until the water table rises. The effective pumping rate has fluctuated from 2.2 gpm to 0.5 gpm. If minimal groundwater pumping cannot be achieved, it will likely be necessary to defer groundwater extraction until the groundwater table rises. In addition, the treatment efficiency and cost of certain systems may be impacted by the reduced flowrates.

Discharge of treated or untreated (depending on the remedial alternative) groundwater will be to the POTW under JASCO's current permit. This permit allows JASCO to discharge water which contain less than 0.75 ppm or any one organic compound and less than 1 ppm total organics. These discharge limitations will be the basis of treatment equipment. The cost for discharging under the current POTW is \$1.25 per 100 cubic feet of discharge, or \$5,500 annually, based on a discharge rate of 6 gpm. The analytical requirement for POTW discharge is a monthly EPA Method 601/602 performed on the effluent. Analytical requirements may change per the POTW. The approximate annual analytical cost would be \$1,500. The total annual cost for discharge to POTW would be \$7,000.

Most of the alternatives provide for treatment of extracted groundwater that contains target constituents above acceptable standards. The treatments recommended have the ability to treat the extracted groundwater to below the groundwater ARARs. This does not mean the concentration of target constituents in the groundwater which remains in the aquifer will decrease correspondingly. A remediation life of 10 years has been suggested as the basis for this FS, however, there is no guarantee that this will achieve the ARARs in the aquifer. Recent theory, based on long term groundwater remediations, suggest that it may be impossible, and impractical, to meet such low cleanup criteria in groundwater aquifers (Pollution Engineering, November, 1991, "Limitations of Pump and Treat Technology, pg. 64).

### 3.1.1 Alternative I: No Action

The "no action" alternative is required for consideration by the EPA. It would require that the current extraction and discharge operations be discontinued and no other remedial action be taken.

**Overall Protection of Human Health and Environment.** According to the Jacobs Endangerment Assessment, under current land use, implementation of this alternative would not endanger public health since the groundwater is not used for any purpose. Future risk exist if the groundwater is used for drinking water; an unlikely scenario, considering the quality of the groundwater.

**Compliance with ARARs.** This alternative could eventually comply with the ARARs through naturally occurring processes such as biodegradation, diffusion, and abiotic degradation. The time required to accomplish this is not known but would likely be a number of decades.

**Long-term Effectiveness and Permanence.** The natural degradation of the target constituents which would occur over the decades would be permanent. However, until degradation of the target constituents is complete, the target constituents could diffuse.

**Reductions in Toxicity, Mobility, and Volume.** The "no action" alternative would not reduce the toxicity or mobility of the target constituents in the short term. The volume of material containing target constituents would increase because of diffusion of the constituents.

**Short-term Effectiveness.** "No action" would not be effective in the short-term. The natural degradation of the constituents is a very long-term process.

**Implementability.** This alternative would be easily implemented. Very little would have to be done to discontinue the current extraction and discharge process.

**Cost.** There would be no cost to implement this alternative.

**State and Community Acceptance.** It is very unlikely that the State or community would accept this alternative.

### 3.1.2 Alternative II: Discharge to POTW

Groundwater would continue to be extracted and discharged to the City of Mountain View's sewage treatment plant. There would be no treatment prior to discharge. A permit from Mountain View is necessary to perform this alternative and has already been obtained.

This alternative is currently being implemented under permit. The existing permit allows JASCO to discharge groundwater containing less than 1 ppm total organic compounds and less than 0.75 ppm of any one compound as detected by EPA Method 601 and 602. Analytical requirements may change per the POTW. If there are any plumes of target constituents, this current treatment scheme would capture them.

The groundwater monitor wells and the discharge would continue to be sampled and analyzed. The monitor wells would be sampled on a quarterly basis to monitor the effectiveness of the extraction system to control the migration of target constituents.



The discharge would be sampled on a monthly basis to verify compliance with the POTW permit. Should concentrations in the discharge exceed permit requirements, the extraction would cease. The discharge would be re-sampled as needed until the concentrations were within the requirements of the permit. Once the concentrations were within the limits of the permit, extraction and discharge would be restarted.

**Overall Protection of Human Health and Environment.** As long as JASCO complies with the permit limit on organic compounds, the POTW will be able to adequately treat the water to a safe level. The target constituents would be removed permanently over the long-term. Migration of constituents would be controlled to prevent degradation of potential drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would not pose a threat to human health or the environment.

**Compliance with ARARs.** Under this alternative, groundwater containing target constituents above MCLs would be extracted. The extraction process would also prevent migration of target constituents.

The POTW which treats JASCO's wastewater is located in Palo Alto and discharges to the San Francisco Bay under a NPDES permit. The POTW's effluent concentrations of the target constituents found in JASCO's groundwater are below detectable levels (Report from Phil Bobel). The groundwater treated by the POTW would comply with the ARARs.

**Long-term Effectiveness and Permanence.** There should be no residual risk once the remedial objectives have been met. The target constituents would be treated off-site by the POTW and no residual target constituents would be produced on-site. Groundwater monitoring should be continued for a pre-determined period of time to ensure no constituents remain in the aquifer.

**Reduction in Toxicity, Mobility, and Volume.** The toxicity, mobility, and volume of target constituents would be reduced by removing the groundwater and preventing further migration of constituents. The groundwater would be extracted and discharged to a POTW. The POTW would treat the groundwater to meet their effluent requirements.

**Short-term Effectiveness.** The implementation of this process poses no threat to the environment or the health of the community or JASCO employees. There is no exposure to the public. The groundwater would be extracted and discharged directly to the POTW. It is estimated that remedial objectives would be met within 10 years.

**Implementability.** This alternative is implementable and currently in use. One well is extracting 2 gallons per minute or less of groundwater which is discharged to a POTW. An extraction system, consisting of additional wells, may have to be installed to control potential target constituent plumes emanating from the site. This is a reliable process. The current process has operated without problems since 1987.

**Cost.** The capital cost would be \$30,000 for the extraction system. The discharge cost of this treatment is \$1.25 per 100 cubic feet of groundwater (Phil Bobel, Environmental Compliance Division, Public Works Department, City of Palo Alto). Assuming an extraction system operating at 6 gpm for 365 days a year, the annual cost for discharge would be \$5,500. In addition, monthly analysis of the groundwater is required using EPA Method 601/602. This would be an annual cost of \$1,500. Total annual cost would be \$7,000. The present worth of this alternative would be \$72,000 based on a 10-year remediation life and 10% discount rate.

**State and Community Acceptance.** If the discharge limits can be consistently met and the source of target constituents is removed, the State and community should accept this alternative. This alternative poses no health threat to the public and should be accepted by the community. This alternative has been selected as the remedy at CTS Printex, another Superfund site in Mountain View.

### 3.1.3 Alternative III: UV Oxidation

This remedial alternative consists of extracting the groundwater and treating it using UV oxidation. UV oxidation treatability studies have been performed on groundwater with similar target constituents from another Superfund site in San Jose, California. During these studies UV oxidation successfully destroyed chlorinated solvents and no additional treatment process was necessary for polishing.

The advantage of using UV oxidation is the destruction of the target constituents rather than transferring them from one media to another. However, this process is fairly sophisticated. Because of this, it is more costly, requires more time to set up, and more attention to maintain. A holding tank would be required because of the low flowrate. The treatment would operate on a batch basis. When enough groundwater has been collected, the system would be operated until the holding tank had been emptied. Treated groundwater would be discharged to the city sewer line under a POTW permit.

There is the potential to produce toxic byproducts that are not totally oxidized. OHM recommends, and the vendors of the process require, an operational treatability study. A treatability study would evaluate UV oxidation's performance on JASCO's site groundwater. This would help to optimize the process for JASCO's site conditions.

**Overall Protection of Human Health and Environment.** This alternative provides for the overall protection of human health and environment by destroying the target constituents in the groundwater. The constituents would be permanently destroyed over the longterm. However, a treatability study should be performed prior to implementation to ensure no toxic by-products are produced from the process. Migration of the constituents would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The implementation and operation of the system would not pose a threat to human health or the environment.

**Compliance with ARARs.** Under this alternative, groundwater containing target constituents above MCLs would be extracted. The extraction process would also prevent migration of target constituents. UV oxidation has been shown to destroy many of the target constituents present in the extracted groundwater to comply with ARARs, although it does not degrade 1,1,1-TCA as effectively as saturated chlorinated hydrocarbons.

**Long-term Effectiveness and Permanence.** If treatability studies demonstrate that ARAR's can be met and after the response objectives have been met, there should be no remaining risk to human health or environment. The process should not produce toxic residual compounds; however, treatability tests are recommended to determine exactly what the byproducts will be. The destruction of the target constituents by UV oxidation is a permanent process.

**Reduction in Toxicity, Mobility, and Volume.** Past treatability studies have demonstrated that UV oxidation is capable of destroying the types of target constituents present at JASCO (Waterworld News, Vol. 3, No. 3, May/June 1987). This treatment would reduce the toxicity, mobility, and volume of target constituents. The UV oxidation process would provide toxicity and volume reduction by permanently destroying the constituents. The mobility of the constituents would be reduced by the extraction system. It would be designed to capture the migration plume.

**Short-term Effectiveness.** The implementation of this process would pose no health threat to the community or JASCO workers. It also poses no threat to the environment. No target constituents would be released to the atmosphere. Groundwater would be contained within the system until it was treated. Once treated, the groundwater would be disposed of off-site by discharging to a POTW. This alternative would result in a reduction in the concentration of target constituents over the short term. Eventually the rate of decrease in concentration would slow down and level off at some concentration. It is estimated the remedial objectives may be met in approximately 10 years.

**Implementability.** This alternative is moderately difficult to implement. The UV oxidation equipment is fabricated off-site and delivered to the site. The difficulty arises from fine-tuning the system to perform optimally. Vendors of UV oxidation claim their systems are reliable and they provide technical support to maintain the operation. Experience indicates that there can be considerable operational and quality problems, especially if the wastewater stream concentrations are inconsistent.

**Cost.** The capital costs are as follows:

UV Oxidation Equipment -	\$140,000
Equalization Tank -	\$ 6,000
Treatability Study -	\$ 5,000
Start-up Cost -	\$ 5,000
Groundwater Extraction System -	<u>\$ 30,000</u>
<b>TOTAL CAPITAL COST -</b>	<b>\$186,000</b>

A treatability study is required by the vendor of this technology. The start-up cost associated with this system is for a field engineer to set-up the system. The cost of a field engineer is \$2,000 for the first week and \$500 for each additional day. Travel cost and expenses have not been included in this cost.

The annual operating costs associated with operating the UV system are as follows:

Process Chemicals & Utilities -	\$ 4,000
Labor -	\$20,000
Discharge to POTW -	<u>\$ 7,000</u>
<b>TOTAL ANNUAL OPERATING COST -</b>	<b>\$31,000</b>

The process chemicals and utilities are based on a vendor quote of \$1.20 per 1000 gallons of water treated. The capital cost and operating cost of the UV oxidation equipment are provided by Ultrox International. Since JASCO will cease operations at this location in the future, labor costs have been included to maintain the system and perform monitoring. System maintenance would be performed by the vendor.

No additional land or site development would be necessary. Since JASCO will cease operations from this location in the future, labor costs have been included to operate the system on a batch basis. Any technical servicing would be performed by the vendor at additional cost.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would be \$370,000.

**State and Community Acceptance.** The State and community would most likely be willing to accept this alternative. It has been accepted by the California Regional Water Quality Control Board for a site in San Jose, California. The operation of the system would not disturb the local residents nor be dangerous to them.

#### 3.1.4 Alternative IV - Liquid Phase Carbon Adsorption

In this alternative, the groundwater is extracted and then treated by passing it through a liquid phase carbon adsorption bed. The target constituents are adsorbed by the carbon, which would be taken off-site for regeneration. A carbon vendor will perform the regeneration by incineration. The regeneration process will destroy the target constituents. The treated groundwater is discharged to the city sanitary sewer under a POTW permit.

The advantage of this system is that it is easily implementable and requires little attention to maintain. "Off the shelf" units can be placed in-line to implement this alternative. Maintenance consists of monitoring the effluent to determine when the carbon units need to be replaced. This process does not, however, destroy the target constituents until the carbon is regenerated; it merely transfers them from the groundwater to the carbon. When the carbon becomes saturated, the carbon vendor replaces the old carbon with new carbon. The old carbon will be regenerated by the vendor.

**Overall Protection of Human Health and Environment.** This alternative provides for the overall protection of human health and environment. The target constituents would be permanently removed over the long term. Migration of the target constituents in the aquifer would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would not pose a threat to human health or the environment.

**Compliance with ARARs.** Under this alternative, groundwater containing target constituents above MCLs would be extracted. The extracted groundwater would be treated by carbon to remove the target constituents from the extracted groundwater to comply with the ARARs. The treated groundwater would meet the discharge requirements under JASCO's POTW permit. The extraction process would also prevent migration of target constituents.

**Long-term Effectiveness and Permanence.** Once the remedial objectives had been met, there would be no residual risk. The process would produce no residual compounds. Removal of the target constituents by carbon is permanent. Monitoring should be continued for a period of time to ensure no target constituents remains in the aquifer.

**Reduction of Toxicity, Mobility, and Volume.** Carbon would absorb the target constituents present in the groundwater. It is expected that this treatment would remove the target constituents to a non-detectable level. This process is permanent and does not produce residual compounds. The toxicity of the target constituents would not be reduced by this method. Once the

carbon was regenerated by incineration, the toxicity would be reduced. The mobility is reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated.

**Short-term Effectiveness.** The implementation of this process poses no risk to the environment or the health of the community or JASCO workers. No target constituents would be released to the atmosphere. Groundwater would be contained within the system. The treated groundwater would be disposed of by discharging to a POTW. Spent carbon would be taken off-site for regeneration. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off. It is estimated that remedial objectives might be met in approximately 10 years.

**Implementability.** This alternative is implementable. The carbon units are "off the shelf" units which are piped into the extraction system. Because carbon adsorption is a relatively simple process, it should be fairly reliable. Effluent would have to be monitored for breakthrough of target constituents. Once there is breakthrough, the unit would be taken out of service and another unit placed on-line. The old carbon unit is regenerated by the carbon vendor. The effectiveness of this alternative is not affected by the low flowrate.

**Cost.** It is difficult to predict the carbon usage at this time since the concentration of target constituents have not remained constant. For estimating cost, water quality data from January 1992 will be used. This data indicates the highest target constituents are diesel fuel and 1,1-dichloroethane (1,1-DCA); except for paint thinner, the other constituents are well below the 0.75 ppm limit. 1,1-DCA will be used here to estimate carbon usage. Additional information (i.e., exact diesel fractions present) would need to be gathered concerning the diesel constituent to determine carbon usage.

At the January 1992 1,1-DCA concentration (0.61 mg/L), the carbon usage would be 1.82 lb per 1,000 gallons. The daily usage will be 16 pounds of carbon. Based on this usage rate, the carbon unit chosen for this alternative is the 350 gallon Calgon Disbosorb. This unit contains 2,500 pounds of carbon and costs \$4,200. The cost to dispose of a unit is \$2,000. At the calculated usage, JASCO will use two of these carbon units annually.

The cost of this alternative is:

Groundwater Extraction System -	\$30,000
Two Initial Carbon Units -	<u>\$ 8,400</u>
TOTAL CAPITAL COST -	\$38,400

The annual operating costs are:

Carbon Disposal -	\$ 6,000
Carbon Unit Replacement -	\$16,800
Labor -	\$ 3,000
Discharge to POTW -	<u>\$ 7,000</u>
TOTAL ANNUAL OPERATING COST -	\$32,800

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would be \$236,000. Since JASCO will cease operations at this location in the future, labor costs have been included to maintain the system and perform monitoring.

This cost is based on operating two units in series. This is the typical method of implementing carbon units. By operating in series, no target constituents will be discharged into the effluent after breakthrough of the first (or lead) carbon unit. Once breakthrough from the lead unit is detected, the second (or lag) unit is placed into service as the lead unit and a fresh unit is placed into service as the lag unit.

**State and Community Acceptance.** The State and community would most likely be willing to accept this alternative. The operation of the units would not disturb the local residents nor be dangerous to them.

### 3.1.5 Alternative V: Air Stripping

This alternative consists of extracting the groundwater and treating it by air stripping. Treated groundwater would be discharged to the POTW. Air stripping of groundwater at JASCO appears to be exempt from emissions control. According to the Bay Area Air Quality Management District's (BAAQMD) regulations (Regulation 8, Rule 47), if an air stripping operation emits less than 1 pound per day of benzene, vinyl chloride, perchloroethylene, methylene chloride, and/or trichloroethylene, it is exempt from emissions control. At this time, if all the target constituents in the groundwater were removed by airstripping (at a influent rate of 6 gpm), it would not emit more than 1 pound per day of the listed constituents (refer to calculations). This alternative transfers the target constituents from the groundwater to the air where they will degrade over time.

If emissions control is needed, the options are passing the air effluent through a carbon bed or through a catalytic oxidizer. If passed through carbon, the volatilized organics would be adsorbed onto the carbon. If passed through a catalytic oxidizer, the volatilized organics would be converted to carbon dioxide and water (for organic compounds) or hydrogen chloride, carbon dioxide, and water (for chlorinated hydrocarbons).

**Overall Protection of Human Health and Environment.** This alternative provides for the overall protection of human health and environment. The target constituents would be permanently removed or destroyed over the long-term. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would pose no threat to human health or the environment. Air emissions would be low and not be considered a health threat.

**Compliance with ARARs.** Under this alternative, groundwater containing target constituents above MCLs would be extracted. Most target constituents in the extracted groundwater could be removed by air stripping to comply with the ARARs. The one constituent which may not be removed by air stripping is diesel fuel. Based on January 1992 data, the concentration of this compound is 0.63 mg/l. This concentration does not exceed the POTW permit and would comply with the ARARs. The treated groundwater would meet the discharge requirements under JASCO's POTW permit.

Air emissions would be less than 1 lb. of benzene, vinyl chloride, perchloroethylene, methylene chloride, and/or trichloroethylene. This would satisfy the requirements for an exemption from BAAQMD's air stripper regulations.

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**Long-term Effectiveness and Permanence.** Once the remedial objectives have been met, there should be no residual risk. The process should produce no residual compounds. Monitoring should be continued for a period of time to ensure no target constituents remains in the aquifer.

**Reduction of Toxicity, Mobility, and Volume.** The target constituents present in the groundwater would be removed by air stripping. It is expected that this treatment would remove the target constituents to a non-detectable level in the treated groundwater. This process is permanent and does not produce residual compounds. The natural degradation of the target constituents would reduce the toxicity. The mobility would be reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated.

**Short-term Effectiveness.** The implementation of this process poses no health threat to the community or JASCO workers and poses no risk to the environment. Air emissions would comply with regulations enforced by the BAAQMD. Groundwater would be contained within the system. The treated groundwater would be disposed of off-site by discharging to a POTW. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off at some concentration. It is estimated the remedial objectives might be met in approximately 10 years.

**Implementability.** This alternative is implementable, although the groundwater flowrates are very low for standard air strippers. The air stripping tower and catalytic oxidizer would be fabricated off-site and delivered to the site. The low flowrate will require this treatment be operated on a batch basis. This will require a holding tank and an automated system to control the air stripper.

Compliance with BAAQMD's Regulation 8, Rule 47 will need to be provided to BAAQMD (i.e., air emissions do not exceed 1 pound per day of chemicals previously stated) to obtain an exemption. If JASCO does not qualify for an exemption, an air permit must be obtained and emission controls installed on the air stripper.

**Cost.** The capital costs are as follows:

Air Stripping Tower w/ automatic control -	\$10,000
Equalization Tank -	\$ 6,000
Extraction System -	<u>\$30,000</u>
TOTAL CAPITAL COST -	\$46,000

The annual operating costs associated with operating the air stripper system are as follows:

Utilities -	\$2,000
Labor -	\$3,000
Discharge to POTW -	<u>\$7,000</u>
TOTAL ANNUAL OPERATING COST -	\$12,000

The utility cost would be for the air blower. Since JASCO will cease operations at this location in the future, labor costs have been included to maintain the system and perform monitoring.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of this alternative would be \$118,000. The present worth of this alternative would increase \$200,000 if

the air effluent were treated by carbon adsorption and \$180,000 if the air effluent were treated using a catalytic oxidizer.

**State and Community Acceptance.** The State would most likely be willing to accept this alternative. It has been chosen as a treatment remedy at other sites in the Santa Clara Valley.

### 3.1.6 Alternative VI: Biological Treatment followed by Carbon Adsorption

This alternative consists of extracting the groundwater and biologically treating it to destroy the majority of non-chlorinated compounds. Carbon would follow the initial biological treatment to remove target constituents (such as TCE and DCE) which may not have biodegraded. Biodegradation of chlorinated hydrocarbons, if complete, would produce carbon dioxide, water, salt, chlorine ions, and/or hydrogen chloride. Treatability studies would have to be performed to determine to what extent the target constituents present could be biodegraded and, consequently, how much carbon would be required. Treatability studies would be required to optimize biological treatment and carbon adsorption to meet the ARARs. OHM suggests that this option be left to the discretion of JASCO, due to the need for EPA-protocol treatability tests, process optimization tests, and highly variable costs (dependent on carbon usage).

The advantage of this alternative, if effective, would be the immediate destruction of many of the higher-concentration constituents. The microorganisms would biologically degrade many of the target constituents. However, the biological treatment of some of the chlorinated compounds present is unproven. Liquid phase carbon would most likely provide the means for removing most of the chlorinated compounds.

Sludge produced from the biological process will be analyzed and disposed of appropriately. Carbon from the process will be regenerated by a permitted facility. Treated groundwater will be disposed to the POTW. This alternative would comply with the ARARs.

**Overall Protection of Human Health and Environment.** This alternative provides for the overall protection of human health and environment. Compounds which are not biologically degraded will be adsorbed onto the carbon. The target constituents would be permanently removed over the long-term, either by bioremediation or carbon adsorption. Migration of the target constituents would be controlled to prevent degradation of drinking water sources. The toxicity, mobility, and volume of the target constituents would be reduced. The operation of the system would be totally enclosed, so would pose no threat to human health or the environment.

**Compliance with ARARs.** The target constituents in the extracted groundwater would either be biodegraded or removed by carbon adsorption to comply with the ARARs.

**Long-term Effectiveness and Permanence.** Once the remedial objectives have been met, there should be no residual risk. If the bioremediation process produced toxic intermediate products, they would most likely be adsorbed on the carbon beds. A treatability study would help to better define any intermediate products. Biodegradation of chlorinated hydrocarbons, if complete, would produce carbon dioxide, water, salt, chlorine ions, and/or hydrogen chloride. There would not be any bio-accumulation of organics within the microorganisms. The sludge from the process will be analyzed to verify this. The sludge will be disposed of properly based on analytical results. The removal of the target constituents by carbon is permanent. Monitoring should be continued for a pre-determined period of time to ensure no target constituents remains in the aquifer.



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**Reduction of Toxicity, Mobility, and Volume.** The biodegradation process would reduce the toxicity and volume of organic hydrocarbons. The extent of biodegradation of the chlorinated organics would need to be determined in a treatability study. However, if these chlorinated compounds are determined to be non-biodegradable, carbon would absorb them. The mobility is reduced by the extraction system. The extraction system would be designed to capture the groundwater. The volume of target constituents present in the aquifer would be reduced as the groundwater was treated, either by biological processes or by carbon adsorption.

**Short-term Effectiveness.** The implementation of this process poses no risk to the environment or to the health of the community or JASCO workers. No target constituents would be released to the atmosphere. Groundwater would be contained within the system. The treated groundwater would be disposed of off-site by discharging to a POTW. This alternative would produce a reduction in the concentration of target constituents in the short term. Eventually the rate of decrease in concentration would slow and level off. It is estimated the remedial objectives might be met in approximately 10 years.

**Implementability.** This alternative is implementable. Biological treatment would require a reactor vessel to contain the microorganisms necessary for the process. These reactor vessels could be fabricated off-site. The carbon units are "off-the-shelf" units which are piped into the extraction system. The reliability of the system would depend on the complexity of the biological treatment. With biotreatment systems, there is always a potential for upsets due to temperature, pH, concentration, or other system shocks.

Effluent from the carbon beds would have to be monitored for breakthrough of target constituents. Once there is breakthrough, the unit would be taken out of service and another unit placed on-line. The old carbon unit would be regenerated by the carbon vendor.

**Cost.** The capital costs are as follows:

Biological Reactor -	\$51,000
Two liquid phase carbon units -	\$ 8,400
Groundwater Extraction System -	<u>\$30,000</u>
TOTAL CAPITAL COST -	\$89,400

The annual operating costs associated with operating the biological treatment system are as follows:

Process Chemicals & Utilities -	\$ 3,000
Labor -	\$ 2,000
Carbon Unit Replacement -	\$0 to \$8,400
Carbon Regeneration -	\$0 to \$4,000
Discharge to POTW -	<u>\$ 7,000</u>
TOTAL ANNUAL OPERATING COST -	\$12,000 to \$24,400

The process chemicals and utilities are estimated. The range of carbon regeneration is based on total biodegradation and no biodegradation. The carbon units priced here are the same disposable units described in Alternative III.

Since JASCO will cease operations at this location in the future, labor costs have been included to maintain the system.

Assuming a 10-year remediation life and a 10 percent discount rate, the present worth of the project would range from \$162,000 to \$236,000.

**State and Community Acceptance.** The State and community would most likely be willing to accept this alternative. The operation of the units would not be dangerous to the local residents nor disturb them.

### 3.1.7 Alternative VII: In-Situ Bioremediation

To be added at a later date.

## 3.2 SOIL REMEDIAL ALTERNATIVES

Soil remediation alternatives are listed below. Approximately 1,100 cubic yards of soil from the former drainage swale area and former diesel fuel storage area will have to be treated or disposed (see Section 1.2.3 for volume estimate). An unknown volume of additional soil may require treatment when the underground tanks are removed.

### Soil Remedial Alternative I: No Action

- No Action

### Soil Remedial Alternative II: Off-site Treatment

- Deed Restrictions
- Excavation
- Off-site RCRA Treatment and/or Disposal

### Soil Remedial Alternative III: Enhanced Biological Treatment

- Deed Restrictions
- Soil Excavation
- Enhanced Biological Treatment
- On-site Replacement

### Soil Remedial Alternative IV: X-19 Biological Treatment

- Deed Restrictions
- Soil Excavation
- X-19 Treatment
- On-site Replacement

### Soil Remedial Alternative V: Excalibur Process

- Deed Restrictions
- Soil Excavation
- Soil Washing (Excalibur Process)
- On-site Replacement

### Soil Remedial Alternative VI: In Situ Bioremediation

- To be provided in an addendum at a later date

The alternative which lists on-site replacement of the soil assumes that the soil can be treated to comply with ARARs.

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The excavation of soil from the former drainage swale area is estimated to cost \$200,000. This is unusually expensive because of the nearby railroad tracks. Excavation of this amount of soil would normally cost from \$3,000 to \$8,000 per 100 cubic yards. "Normal" excavation procedures may cause slumping of the soil and damage the nearby railroad tracks. Since damage to these active tracks is unacceptable, excavation of soil in the drainage swale would be performed with a drill rig. Large augers, approximately 36" in diameter, would be used to "drill out" the soil. After the borehole was completed, it would be backfilled with concrete to prevent slumping of adjacent soil. It is estimated that 1,100 cubic yards of soil (see Section 1.2.3.1 for estimated volume) would be excavated from the drainage swale area and treated. The estimated cost of excavation (\$200,000) is based on identical excavation operations performed previously in the former drainage swale area. The cost includes mobilizing the equipment, "drilling out" the soil, backfilling the boreholes, and demobilization. The cost of treatment alternatives are based on treating 1,100 cubic yards of soil.

The preferred treatment approach would be an in-situ process, such as vapor extraction or bioremediation, to avoid the high cost of excavation. These will not be considered at this time because soil characteristics at JASCO (clay with sand) are inappropriate for vapor extraction. Clays have very low permeabilities and sands have very high permeabilities. If vapor extraction were used, air would be drawn through the sand preferentially and have little effect on the target constituents held within the clays. There is a possibility in-situ bioremediation may be successful. Treatability studies will be conducted to determine the effectiveness of in-situ bioremediation. Results from the treatability studies will be reviewed and a decision will be made at a later date regarding utilizing in-situ bioremediation as a remediation alternative.

For the alternatives where on-site treatment is performed, the soil will be placed back on-site. The soil remediation objective concentrations are low enough to satisfy the land ban treatment requirements and soil replacement on-site could be performed.

### 3.2.1 Alternative I: No Action

As with Groundwater, the No Action option must be retained. No treatment would be implemented and the soil would simply be left in place.

**Overall Protection of Human Health and Environment.** Under the current land-use, implementation of this alternative would not directly endanger public health. This alternative does not provide protection for the environment. Target constituents could migrate from soil to groundwater and might further degrade the groundwater quality.

All current and potential future risks would remain with this alternative. The Jacobs Endangerment Assessment has demonstrated that "contaminants detected at the Jasco site pose no threat to the public health under current land-use conditions. However potential future land-use scenario are described which could pose higher health risks." The future land-use scenario described entail direct ingestion of the A-aquifer groundwater.

**Compliance with ARARs.** This alternative could eventually comply with the ARARs through naturally-occurring processes such as biodegradation, diffusion, and abiotic degradation. The time required to accomplish this is not known but would likely be a number of decades.

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**Long-term Effectiveness and Permanence.** The natural degradation of the target constituents which would occur over the decades would be permanent. However, as this natural degradation occurs, the population at risk could increase if the target constituents migrate to the groundwater.

**Reductions in Toxicity, Mobility, and Volume.** This alternative would not reduce the toxicity or mobility of the target constituents in the short term. The volume of target-constituent-containing material would increase because of diffusion and leaching of the constituents.

**Short-term Effectiveness.** "No Action" would not be effective in the short-term. The natural degradation of the target constituents is a very long-term process.

**Implementability.** This alternative would require no effort to implement.

**Cost.** There would be no cost required to implement this alternative.

**State and Community Acceptance.** It is not likely that the State or community would accept this alternative.

### 3.2.2 Alternative II: Off-site Treatment

Soil containing target constituents would be excavated and transported off-site for treatment and disposal at a RCRA permitted facility.

Treating and disposing of the soil off-site has the advantage of removing soil containing target constituent from the site. However, JASCO would still be responsible for the soil. This is an expensive alternative. The soil would most likely have to be transported out of state for incineration since there are no incinerators in California.

**Overall Protection of Human Health and Environment.** This alternative provides for the overall protection of human health and environment. The soil would be properly treated and disposed of by a RCRA permitted facility. The treatment would most likely be incineration which would permanently destroy the target constituents. The toxicity, mobility, and volume of target constituents would be reduced. Precautions would be taken to reduce the amount of the airborne constituents during excavation of soil to prevent exposure to workers and nearby residents. There is always a risk associated with transporting hazardous material off-site since there is the potential for a spill, accident, or future liability at the TSD facility.

**Compliance with ARARs.** This alternative would comply with the ARARs. Target constituents would be removed from the site and be totally destroyed by off-site treatment.

**Long-term Effectiveness and Permanence.** There would be no residual risk at the site. On-site, there would be no byproducts of this treatment alternative. At the treatment facility, the incineration would reduce the target constituents to non-toxic compounds. This alternative offers permanent removal of the target constituents.

**Reductions in Toxicity, Mobility, and Volume.** Since the target constituents would be removed from the site and destroyed, the toxicity, mobility, and volume would be reduced with this alternative.

**Short-term Effectiveness.** There is a risk that excavation of soil could produce airborne particulates. Dust suppression would be practiced during excavation to prevent particulates from becoming airborne. No other risk to human health or environment would exist during implementation of this alternative at the site. This alternative could be completed in less than six months.

**Implementability.** This alternative would not be difficult to implement. A TSD facility would have to be located that would accept the soil and the soil would need to be properly manifested for transportation.

**Cost.** Off-site treatment of the soil would most likely be necessary prior to disposal. The off-site treatment would be incineration.

Excavation -	\$ 200,000
Transportation -	\$ 93,000
Treatment & Disposal -	<u>\$1,390,000</u>
TOTAL -	\$1,683,000

Transportation costs are based on \$50 per hour per truck. It would take 62 truckloads 30 hours (portal to portal) to transport all the soil. The cost for treatment and disposal is \$0.45 per pound of soil. The cost for disposal could decrease to \$400 per ton if no incineration is required.

**State and Community Acceptance.** This alternative would most likely be accepted by the State and community. The alternative could be safely implemented and target constituents would be removed leaving no health risk to the local population.

### 3.2.3 Alternative III: Enhanced Biological Treatment

Soil containing target constituents would be excavated, prepared, and placed in a totally enclosed reactor vessel (which might consist of soil contained between sealed liners) for enhanced biological treatment. Preparation of the soil would consist of mixing the soil and adding a bulking agent and nutrients for the microorganisms. Mixing the soil and adding in a bulking agent aids the process by making the soil more permeable to air and water. Indigenous microorganisms could be used, or specialized microbial consortia could also be added. The activity of the microorganisms would be increased by the addition of nutrients.

The reactor vessel would have an air distribution system along the bottom. Air would be drawn through this distribution system to provide oxygen to the microorganisms and to simultaneously extract volatile organics. This air stream is passed through carbon to adsorb volatile organics which are extracted from the soil. This process is suited for the mixture of target constituents at JASCO. The chlorinated hydrocarbons, which are not easily biodegraded, are volatile and would be extracted by the air and adsorbed on carbon. The heavier hydrocarbons, which are less volatile, would be biodegraded.

This is similar to vapor extraction, only performed ex-situ. This is a better application than in-situ vapor extraction because the soil is homogenized for better air flow through the soil.

This alternative would provide a cost-effective option to biologically destroy the non-volatile target constituents (and some of the volatiles as well) and to adsorb volatile compounds onto carbon beds. This alternative is expected to be effective.

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**Overall Protection of Human Health and Environment.** It is expected that operation of this process would not pose a threat to human health or environment. Chlorinated compounds would be adsorbed on carbon and the other target constituents, as well as some of the chlorinated compounds, would be biodegraded.

**Compliance with ARARs.** This alternative would most likely meet ARARs. Organic hydrocarbons have been shown to be biodegradable. Chlorinated hydrocarbons are less biodegradable, but are very volatile. These volatile compounds would be adsorbed in the carbon beds.

**Long-term Effectiveness and Permanence.** This alternative would provide long-term effectiveness and permanence since the target constituents would either be removed from the soil, or biodegraded.

**Reduction of Toxicity, Mobility, and Volume.** Enhanced biological treatment would provide a reduction in toxicity, mobility, and volume of target constituents.

**Short-term Effectiveness.** Proper implementation of this alternative would pose no threat to the community, JASCO workers, or the environment. Dust suppression would be practiced during excavation to prevent particulates from becoming airborne. No other risk to human health or environment would exist during implementation of this alternative. This alternative could be completed in less than 2 years.

**Implementability.** This alternative is implementable. OHM and other companies have implemented this type of process. Once all the preparation has been completed, it requires little attention. Carbon canisters would need to be monitored for breakthrough of target constituents.

**Cost.** The cost for this alternative would be:

Excavation -	\$200,000
Treatment -	<u>\$165,000 to \$248,000</u>
TOTAL -	\$365,000 to \$448,000

The total cost range of this alternative reflects a cost of \$150 to \$225 per cubic yard of soil and is based on past experience.

**State and Community Acceptance.** The State and community would most likely accept this alternative. The implementation and operation of the process would not pose a threat to human health or environment. The microorganisms used would most likely be those which are native to the soil, so would pose no threat to human health or environment. If non-native microorganisms are used, they would be naturally occurring and not engineered. It would also provide permanent destruction, or removal by carbon adsorption of the target constituents.

### 3.2.4 Alternative IV: X-19 Biological Treatment

Soil containing target constituents would be excavated and treated using the X-19 amendment process. The X-19 process has been proven to effectively biodegrade petroleum hydrocarbons and other organics that are readily biodegradable. The developer has presented information that suggests that the microbial consortium in X-19 is capable of degrading more recalcitrant

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chlorinated organics as well. However, to date the process has not been tested using an EPA-approved protocol or other enclosed bioreactor study with a detailed mass balance. There are indications that this process could indeed be effective, but it would be necessary to conduct an EPA-protocol treatability study to demonstrate that the chlorinated compounds were indeed being biodegraded.

This process would be applied by mixing the X-19 additive into the soil in a controlled manner (with water) to avoid volatilization of the target constituents, while also mixing in any nutrients required. The soil would then be placed either on a liner, securely covered with an additional liner/cover, or all of the soil would be placed in a secure treatment vessel. The vendor states that within several months, the microorganisms will have completed their work of degrading the organics to non-detectable levels. If this process is effective, it will require minimal handling and attendance and the soil could be reused on site as a soil amendment after treatment was complete.

**Overall Protection of Human Health and Environment.** This process would be protective of human health and the environment as long as it was contained (to eliminate any emissions) and it was effective in degrading all target constituents. The only potential for exposure would be during the initial excavation and the final soil removal (if the target constituents were not destroyed). During excavation moisture would be added to the soil to minimize the emissions. It would simultaneously provide the moisture required for bioremediation to occur. The organisms used are naturally occurring and non-genetically engineered organisms.

**Compliance with ARARs.** Compliance with ARARs cannot be demonstrated without performing a treatability test. With bioremediation the cost of treatment increases substantially as one decreases the cleanup criteria. Although the vendor has claimed that non-detectable levels can be achieved, experience indicates that treatment of extremely low levels of target constituents requires a primary substrate to sustain the microbial culture. The microbes will then continue to consume the target constituents as a secondary food source.

**Long-term Effectiveness and Permanence.** Those target constituents that could be biodegraded would be permanently biodegraded. It is unknown whether the chlorinated compounds would be completely biodegraded. There is a possibility that biodegradation would continue to take place beyond the initial treatment period. Most of the biodegradation would be completed in the soil pile within a relatively short period (less than one year) while controlled treatment was being conducted.

**Reductions in Toxicity, Mobility, and Volume.** This process should reduce the above characteristics for the non-chlorinated target constituents present. However, it is unknown to what extent it would reduce these characteristics for the chlorinated organic target constituents. Only a detailed treatability study can provide this information for the soil matrix and specific target constituents present.

**Short-term Effectiveness.** If this process is effective, whatever degradation occurs should be completed within one year, so it would provide short-term effectiveness for those target constituents it is capable of degrading.

**Implementability.** This process would be fairly easy to implement at the Jasco site in Mountain View. Whether the liner approach or contained bioreactor approach was used, treatment could be conducted at the site. There appears to be adequate space available for on-site treatment since the volume of soil to be treated is relatively small (approximately 1,100 CY). If the soil volume

exceeded the quantity that could be practically treated at one time, the soil could be treated in stages, although JASCO prefers to treat the soil in the shortest time period possible, considering the future land use.

**Cost.** The cost for this alternative would be:

Excavation -	\$200,000
Soil handling -	\$ 30,000 to \$50,000
X-19 Consortium -	\$ 18,500
EPA Treatability Study -	<u>\$ 30,000 to \$50,000</u>
TOTAL -	\$278,500 to \$318,500

The per ton cost of X-19 is \$50. Assuming a 3:1 volume mixture of soil to X-19 and a density of 1 ton per cubic yard, 370 tons of material would be used.

**State and Community Acceptance.** Bioremediation processes tend to be accepted by regulatory agencies and communities if the microorganisms used are not genetically engineered or otherwise dangerous to human health. Considerable resistance would not be expected provided: 1) the process was contained; 2) it could be proven that the microorganisms did not present any health danger and; 3) the hazardous compounds were controlled during excavation, mixing and placement.

### 3.2.5 Alternative V: Excalibur Process

This alternative has been included because preliminary results have indicated that ultrapure water is very effective in dissolving all types of target constituents in soils, from sand through clay. It has been implied that ultrapure water is a "universal solvent". The inventors claim that ultrapure water, in combination with UV ozonation and ultrasound, is much more effective than traditional UV oxidation processes in destroying a mixture of organic compounds. There is not extensive data available on this process, since it is a fairly new and innovative process. It may be beneficial to perform a treatability study to further evaluate this process, dependent upon the results of this feasibility study. OHM recommends that this be left to the discretion of JASCO, since this is a very innovative technology and would require treatability testing without any assurances that the process would be viable.

**Overall Protection of Human Health and Environment.** If this process is shown to be effective, it would protect the environment by removing and destroying the target constituents present, rather than only transferring them to another media. There would be a minor risk associated with the operation of a small ozone-generating system in a residential neighborhood, so the system's safety controls would have to be thoroughly reviewed and approved.

**Compliance with ARARs.** The vendors of the Excalibur process claim it would be capable of treating the soil to comply with the ARARs. They recommend a treatability study to confirm the effectiveness.

**Long-term Effectiveness and Permanence.** If effective, this system would permanently destroy organic constituents during the on-site treatment operation. The pertinent question relates to the level of decontamination that could be achieved and whether this process would destroy all of the target constituents of concern that are present. This can only be determined by conducting a treatability and/or pilot study.



**Reductions in Toxicity, Mobility, and Volume.** This option would reduce all of the above properties by destroying the organic constituents. The extent to which this process could reduce these properties for the target constituents present in the JASCO soil is unknown.

**Short-term Effectiveness.** If this process is demonstrated to be effective (in treatability or pilot tests), it would be effective within the short term since once a fullscale system is built the treatment process could be completed in a relatively short period of time. It is assumed that treatment would be completed within one year or less.

**Implementability.** A mobile treatment skid is available to treat up to five cubic feet of solids per hour. This is a pilot scale system that could not cost-effectively treat the total volume of soil containing target constituents at the Jasco site. Excalibur has not yet built a fullscale treatment system. If they were to develop and build such a treatment system, implementation at the site should be straight-forward, as this would be a short term operation. However, at this time there is no assurance that a fullscale system will be built.

**Cost.** The cost of this alternative would be:

Excavation -	\$200,000
Treatability Test -	\$ 50,000
Treatment -	<u>\$ 88,000 to 220,000</u>
TOTAL -	\$338,000 to \$470,000

The treatment cost is based on an estimated of \$80 to \$200 per cubic yard of material to be treated.

**State and Community Acceptance.** It is likely that the State and community would accept this process because it is very similar to other UV oxidation processes being used at Superfund sites and past precedent has been set to for such a system at a nearby site.

#### 3.2.6 Alternative VI: In-situ Bioremediation

To be added in an addendum.

## 4.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the alternatives were then evaluated with respect to the nine evaluation criteria. The nine criteria as defined in the National Contingency Plan and CERCLA Section 121(b) and 121(c) are:

- o Overall Protection of Human Health and the Environment
- o Compliance with ARARs
- o Long-Term Effectiveness and Permanence
- o Short Term Effectiveness
- o Reduction of Contaminant Toxicity, Mobility or Volume
- o Implementability
- o State Acceptance/Support Agency Acceptance
- o Community Acceptance
- o Cost

The following is a summary of this analysis.

### 4.1 GROUNDWATER REMEDIATION ALTERNATIVES

**Overall Protectiveness.** Alternative I: No Action would provide no additional protection of human health and the environment beyond the present local restrictions on use of A-aquifer groundwater. Expansion of the existing target constituent plume would occur under this alternative. Alternatives II to V would be protective of human health and the environment because each involves the extraction and treatment of constituent-laden groundwater and the containment of the present constituent plume. Alternatives II to V would equally mitigate significant risks to human health associated with the ingestion of A-aquifer groundwater and the inhalation of groundwater vapors.

**Compliance With ARARs.** Alternative I: No Action would not comply with ARARs as the groundwater would continue to contain target constituents at concentrations exceeding MCLs and the potential for migration of target constituents to potable drinking water sources would remain. Alternatives II to V are expected to provide compliance with ARARs. Alternative II: Discharge to POTW, which has been implemented at the Site since 1987, is expected to comply with the existing permit administered by the City of Mountain View based upon recent discharge data. Alternatives III to V will comply with the existing discharge permit because each would incorporate an on-site pretreatment step prior to discharge. The ability of Alternatives II to V to remediate groundwater to MCLs is dependent upon the implementation of soil remedial alternatives and the design of the extraction system. Alternatives II to V would be equally effective at meeting MCLs as each involves the extraction and treatment of constituent-laden groundwater.

**Long-Term Effectiveness.** Alternative I: No Action would be relatively ineffective at long-term reduction of the magnitude of residual risk. The target constituents present could degrade naturally under this alternative although there would be no engineering control of the process and the alternative would not be a reliable method of remediating groundwater. Alternatives II to V would be expected to provide effective long-term reduction of risks through the removal and treatment of affected groundwater and the containment of the constituent plume. Alternative II: Discharge to POTW is a reliable process that has been in use at the Site since 1987. Alternatives III to V are reliable processes based upon their application at other sites, however, their reliability under Site conditions would be dependent upon system design. The reliability of the carbon

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adsorption process utilized under Alternative IV (liquid phase) and potentially under Alternative V (air phase) is dependent in part on the interaction between the loading capacities of the target constituent suite. If implemented, each alternative should undergo a five-year review both to determine the need for further remediation and to establish the effectiveness of the process.

**Short-Term Effectiveness.** There would be no significant risks to on-site workers during the implementation of Alternative I: No Action although the effectiveness at maintaining community protection would be dependent upon the local restrictions on A-aquifer groundwater use. The implementation protocol for Alternatives II to V would be protective of on-site workers and the community. The only potential environmental impact would be the continued drawdown on the A-aquifer required for groundwater containment. A ten-year action time has been estimated for all alternatives involving groundwater extraction although the actual action time required will be dependent upon the implementation of soil remediation alternatives and the variability of maximum sustainable pumping rates.

**Reduction of Toxicity, Mobility and/or Volume.** Alternative I: No Action would provide for no further reduction of the toxicity, mobility and/or volume of target constituents other than that which would occur through normal attenuation and would not satisfy the statutory preference for treatment. Alternatives II to V would provide a reduction of the total mass and volume of target constituents at the Site through the extraction of affected groundwater. Alternatives II to V would also provide for the reduction of toxicity and mobility of target constituents through the treatment processes each will employ. Alternatives II to V involve a off-site treatment step at the POTW after discharge. All target constituents in extracted groundwater under alternatives III to V would be irreversibly destroyed either in the on-site treatment process (e.g. UV Oxidation) or during the regeneration of materials to which the contaminants were transferred on-site (e.g. carbon adsorption). The statutory preference for treatment would be satisfied under alternatives III to V and may be satisfied under Alternative II depending upon the POTW process.

**Implementability.** Alternative I: No Action would involve no facility construction and would not affect the ability to implement further actions. Alternatives II to V would be relatively easy to construct and operate. Alternative V: Air Stripping could be more difficult to construct if it were to involve a holding tank and an automated system to hold, treat and discharge wastewater. Under the low flowrates that are expected, however, a flow-through system may be utilized which would be as easy to construct as the other alternatives. Alternative III: UV Oxidation would likely be the most difficult to operate due to the difficulties in fine-tuning the system to maintain optimal system performance. Alternatives II to V would not significantly affect the ease of adding additional treatment processes. Each of the alternatives utilize available technologies supplied by vendors that could provide the required equipment, materials and support.

**State and Community Acceptance.** Each of the alternatives would be feasible to implement from an administrative viewpoint. Alternative I: No Action would likely not be acceptable to the state or the community. Alternatives II to V would be expected to be acceptable to the community at their anticipated scope.

**Cost.** There would be no cost for the implementation of Alternative I: No Action. Of the remaining alternatives, Alternative II: Discharge to POTW would be the least costly to implement with a present worth of \$72,000. This alternative would involve a maximum capital cost of \$30,000 for the potential installation of additional extraction wells and approximately \$7,000 annually for monitoring and discharge costs. The most expensive alternative to implement would be Alternative III: UV Oxidation with a present worth of \$370,000. Capital costs would be

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approximately \$186,000 with an estimated annual cost of \$31,000. The present worth of Alternative IV: Carbon Adsorption is estimated at \$236,000. The present worth of Alternative V: Air Stripping is \$118,000. The need for treatment of air-effluent is not anticipated under Alternative V, however, if such treatment is necessary the present worth of this alternative would increase by between \$180,000 and \$200,000.

## 4.2 SOIL REMEDIATION ALTERNATIVES

**Overall Protectiveness.** Alternative I: No Action would provide no additional protection of human health and the environment. Further migration of target constituents in soil could occur. Alternatives II and III would reduce risks to human health at the Site through the removal and treatment of affected soil. A treatability study would have to be conducted to determine the effectiveness of Alternatives IV and V at protecting human health. Alternatives II to V would be protective of the environment because each involves the removal of affected soil as well as measures to prevent further migration of target constituents in soil.

**Compliance With ARARs.** Alternative I: No Action would not comply with ARARs, as the affected soil would remain in place with no treatment. Alternative II: Off-Site Discharge would comply with ARARs. Alternative III: Enhanced Bio-treatment would be expected to comply with ARARs based on the biodegradability and volatility of the target constituents. The ability of alternatives IV and V to comply with ARARs would be determined during the treatability study.

**Long-Term Effectiveness.** Alternative I: No Action would be relatively ineffective at long-term reduction of the magnitude of residual risk. The risks associated with the migration of target constituents to groundwater would remain. The target constituents present could degrade naturally under this alternative. There would be no engineering control of the process and the alternative would not be a reliable method of remediating affected soil. Alternatives II to V would be expected to provide effective and permanent long-term reduction of residual risks through the removal of affected soil. Alternatives II, III and IV utilize reliable treatment methods and provide adequate controls. The Excalibur treatment process utilized under Alternative V is a recent development and its reliability is unknown. A five-year review would be required only for the No Action alternative. The treatment processes under alternatives II to V are not expected to take five years to complete.

**Short-Term Effectiveness.** There would be no significant risks to on-site workers under Alternative I: No Action. Dust control may be required during the excavation step of Alternatives II to V to protect against dermal contact and inhalation of dust containing target constituents. No short-term environmental impacts would be expected under alternatives II to V. Under Alternative II: Off-Site Treatment approximately six months would be required to complete the action. Under alternatives III to V, which involve on-site treatment, between one and two years would be required.

**Reduction of Toxicity, Mobility and/or Volume.** Alternative I: No Action would provide for no further reduction of the toxicity, mobility and/or volume of target constituents other than that which would occur through normal attenuation and would not satisfy the statutory preference for treatment. Alternatives II to V would provide a reduction of the total mass, volume and mobility of target constituents at the Site through the excavation, containment and treatment of affected soil. Target constituents in excavated soil under Alternative II: Off-Site Treatment would be irreversibly destroyed through off-site incineration. Under Alternative III: Enhanced Bio-treatment target constituents would be irreversibly destroyed either during biodegradation or during the

regeneration of materials to which the contaminants were transferred on-site (e.g. carbon adsorption). Very low levels of organic constituents may remain in the excavated soil under Alternative III. A treatability study is recommended for Alternatives IV and V to determine their effectiveness at reducing the toxicity, mobility and volume of target constituents in soil. The statutory preference for treatment would be satisfied under alternatives II to V.

**Implementability.** Alternative I: No Action would involve no facility construction and would not affect the ability to implement further actions. Alternatives II to IV would be easy to construct and operate. The ease of constructing and operating Alternative V is unknown because the Excalibur Process was only recently developed. The incineration of affected soil under Alternative II may limit the application of additional actions. Alternatives III to V would not significantly affect the ease of adding additional treatment processes. Alternative II: Enhanced Bio-treatment utilizes available technologies supplied by multiple vendors that could provide the required equipment, materials and support. The number of incineration facilities that could handle Site wastes under Alternative II is limited and only one vendor exists for the X-19 and Excalibur processes under alternatives IV and V.

**State and Community Acceptance.** Each of the alternatives would be feasible to implement from an administrative viewpoint. Alternative III: Enhanced Bio-treatment would require an air emissions permit from the Bay Area Air Quality Management District. Alternative I: No Action would likely not be acceptable to the state or the community. Alternatives II to V would be expected to be acceptable to the community at their anticipated scope.

**Cost.** There would be no cost for the implementation of Alternative I: No Action. Each of the remaining alternatives include an estimated cost of \$200,000 for the excavation of affected soil. The most expensive alternative would be Alternative I: Off-Site Disposal with an estimated cost of \$1,683,000. Of the alternatives involving on-site treatment, Alternative IV: X-19 Treatment would be the least costly to implement with an estimated cost of between \$278,500 and \$318,500. The estimated cost for Alternative III: Enhanced Bio-treatment would range between \$365,000 and \$448,000 and the estimated cost for Alternative V: Excalibur Treatment would range between \$338,000 and \$470,000.

**TABLES**

Table 1.1  
Maximum Concentration of Target Constituents  
Detected in Soil Samples,  
Drainage Swale Area DS-1

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	DATE	DEPTH (ft)
1,1-Dichloroethane (1,1-DCA)	3.0	7/90	30'
1,1-Dichloroethene (1,1-DCE)	1.7	7/90	5'
1,2-Dichloroethene (1,2-DCE)	0.015	7/90	25'
1,1,1-Trichloroethane (1,1,1-TCA)	61.0	7/90	5'
Acetone	8.8	5/88	3'
Benzene	0.12	6/90	1'
Bromoform	0.17	7/90	25'
Ethanol	0.7	5/88	3'
Ethylbenzene	0.37	6/90	1'
Isopropanol	76.0	7/90	3'
Methanol	60.0	7/90	3'
Methylene Chloride	4.2	7/90	20'
Toluene	110.0	7/90	5'
Tetrachloroethene (PCE)	4.0	7/90	25'
Trichloroethene (TCE)	0.015	7/90	3'
Total Petroleum Hydrocarbons:			
as Kerosene	10.0	5/88	3'
as Paint Thinner	5.2	5/88	3'
High Boiling Point (bp)	290.0	6/90	1'
Low-Medium bp	6700.0	7/90	5'
Xylene	37.0	7/90	5'

Table 1.2  
Maximum Concentration of Target Constituents  
Detected in Soil Samples,  
Drainage Swale Area DS-2

CONSTITUENT	MAXIMUM CONCENTRATION (mg/kg)	DATE	DEPTH (ft)
1,1-Dichloroethane (1,1-DCA)	0.61	5/88	3'
1,1,1-Trichloroethane (1,1,1-TCA)	0.44	5/88	3'
Acetone	100.0	5/88	3'
Benzene	0.0079	6/90	1'
Ethanol	3.4	5/88	3'
Ethylbenzene	1.2	5/88	3'
Isopropanol	164.0	5/88	3'
Methanol	9.0	5/88	3'
Methylene Chloride	6.2	5/88	3'
Methyl Ethyl Ketone	1.9	5/88	3'
Tetrachloroethene (PCE)	0.24	5/88	3'
Toluene	8.2	5/88	3'
Total Petroleum Hydrocarbons:			
as Diesel	14.0	6/87	6'
as Paint Thinner	170.0	5/88	3'
High Boiling Point (bp)	48.0	6/90	1'
Low-Medium bp	1.4	6/90	0.5'
Xylene	11.0	7/90	3'



10/24/87

Table 1.3  
Estimated Quantity of Target Constituents  
in Former Drainage Swale Area

Constituent	Total # of Samples	Average Concen. mg/kg	Quantity in lbs (2)	Quantity in gal (3)
1,1,1-TCA	68	1.4153	4.3497	0.3625
1,1-DCA	68	0.1891	0.5812	0.0593
1,1-DCE	68	0.2263	0.6955	0.0756
Bromoform	68	0.1930	0.5932	0.0247
Methylene Chloride	68	0.5969	1.8345	0.1653
Tetrachloroethene	68	0.1095	0.3365	0.0247
Trichloroethene	68	0.0484	0.1488	0.0122
Acetone	68	2.3157	7.1171	1.0783
Ethanol	65	0.5023	1.5438	0.2339
Isopropanol	65	5.8538	17.9911	2.7679
Methyl Ethyl Ketone	20	0.4600	1.4138	0.2110
Methanol	65	4.9354	15.1685	2.2983
Benzene	78	0.0439	0.1349	0.0185
Ethylbenzene	78	0.0781	0.2400	0.0333
Toluene	78	2.3293	7.1589	0.9943
Xylene	78	1.1639	3.5771	0.4834
High BP HC (*)	65	8.4969	26.1144	3.6270
Low-Med BP HC (**)	65	290.0477	891.4326	123.8101

- (1) - calculated by dividing the sum the analytical results of all soil samples collected from within the area by the the total number of samples collected from the area. Non-detectable results are considered to be equal to the detection limit of the analyses.
- (2) - assuming volume of 1100 cubic yards at 1.4 tons/cubic yard  
= 1540 tons or 3,080,000 lbs (1,400,000 kg)
- (3) - using densities per The Merck Index, 1976
- (\*) - including results of analyses for diesel fuel
- (\*\*) - including results of analyses for kerosene, lacquer thinner and paint thinner

Table 1.4  
Estimated Quantity of Target Constituents  
in Underground Storage Tank Area

Constituent	Total # of Samples	Average Concen. mg/kg (1)	Quantity in lbs (2)	Quantity in gal (3)
1,1-DCE	25	0.0374	0.1251	0.0136
1,1,1-TCA	25	0.0394	0.1318	0.0110
Acetone	25	0.2194	0.7337	0.1112
Isopropanol	25	0.9840	3.2905	0.4986
Methanol	25	1.4080	4.7084	0.1308
Methylene Chloride	25	0.3222	1.0774	0.0971
Toluene	25	0.0376	0.1257	0.0175

- (1) - calculated by dividing the sum the analytical results of all soil samples collected from within the area by the the total number of samples collected from the area. Non-detectable results are considered to be equal to the detection limit of the analyses.
- (2) - assuming volume of 1200 cubic yards at 1.4 tons/cubic yard  
= 1680 tons or 3,360,000 lbs (1,520,000 kg)
- (3) - using densities per The Merck Index, 1976

Table 1.5  
Estimated Quantity of Target Constituents  
in Former Diesel Storage Tank Area

Constituent	Total # of Samples	Average Concen. mg/kg (1)	Quantity in lbs (2)	Quantity in gal (3)
Methylene Chloride	14	0.0643	0.0066	0.0006
Benzene	14	0.2850	0.0295	0.0040
Toluene	14	0.1371	0.0142	0.0020
Xylene	14	1.2857	0.1329	0.0180
High BP HC (*)	14	30.7857	3.1832	0.4421

- (1) - calculated by dividing the sum the analytical results of all soil samples collected from within the area by the the total number of samples collected from the area. Non-detectable results are considered to be equal to the detection limit of the analyses.
- (2) - assuming volume of 37 cubic yards at 1.4 tons/cubic yard  
= 52 tons or 104,000 lbs (47,000 kg)
- (3) - using densities per The Merck Index, 1976
- (\*) - includes results of analyses against a diesel fuel standard

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TABLE 1.6  
COMPARISON OF LABORATORY RESULTS  
OF GROUNDWATER SAMPLING (1984 to 1991)

Target Constituent	Maximum Concentration 1984-1988		Maximum Concentration 1989		Maximum Concentration 1990		Maximum Concentration 1991	
	mg/l	Well	mg/l	Well	mg/l	Well	mg/l	Well

A-AQUIFER

1,1,1-TCA	2.04	V-2	1.7	V-4	0.14	V-4	0.094	V-4
1,1-DCA	2.2	V-4	7.8	V-4	0.29	V-4	0.65	V-4
1,1-DCE	0.17	V-4	0.19	V-4	0.038	V-4	0.038	V-4
1,2-DCA	2.58	V-2	nd		nd		nd	
1,3-Dichlorobenzene	0.025	V-2	nd		nd		nd	
Trans-1,2-DCE	0.012	V-3	0.2	V-3	nd		nd	
4-Nitrophenol	nd		nd		0.037	V-1	nd	
Acetone	1.2	V-2	1.7	V-4	0.1	V-4	0.033	V-8
Benzene	0.02	V-2	0.011	V-3	nd		nd	
Bromoform	0.0051	V-4	nd		nd		nd	
Carbon Tetrachloride	0.005	V-7	nd		nd		nd	
Chlorobenzene	0.037	V-2	nd		nd		nd	
Chloroethane	0.17	V-2	0.39	V-4	0.012	V-4	0.11	V-4
Chloroform	0.0007	V-7	nd		nd		nd	
Dibromochloromethane	0.0026	V-4	nd		nd		nd	
Ethanol	0.55	V-1	16	V-4	0.2	V-4	nd	
Ethylbenzene	0.012	V-2	nd		nd		nd	
High B.P. Hydrocarbons	20	V-3	33	V-3	1.1	V-1	0.62	V-4
Isopropanol	0.44	V-1	1.4	V-4	nd		nd	
Methanol	2.7	V-3	0.73	V-4	3.8	V-3	nd	
Methyl Ethyl Ketone	0.027	V-2	na		na		nd	
Methylene Chloride	142	V-2	3.5	V-4	0.053	V-3	0.15	V-4
Pentachlorophenol	0.05	V-3	nd		0.023	V-1	nd	
Phenol	0.0032	V-4	nd		nd		nd	
Tetrachloroethene	0.008	V-2	nd		nd		nd	
Toluene	0.25	V-2	nd		nd		nd	
Trichloroethene	0.019	V-2	nd		nd		nd	
Vinyl Chloride	0.016	V-4	0.0026	V-4	0.0054	V-4	0.0064	V-4
Xylene	0.08	V-2	0.003	V-3	nd		nd	

B(1)-AQUIFER

1,1,1-TCA	0.0068	I-2	0.0036	I-2	0.0032	I-2	0.0031	I-2
1,1-DCA	0.014	I-2	0.0046	I-2	0.003	I-2	0.0027	I-2
1,1-DCE	0.0071	I-2	0.0026	I-2	0.0022	I-2	nd	
Acetone	0.13	I-1	nd		nd		nd	
Methylene Chloride	0.032	I-1	nd		nd		nd	
Phenol	0.02	I-3	nd		0.0036	I-3	nd	
Vinyl Chloride	0.004	I-3	nd		nd		nd	

Table 1.7

# Historic Frequency of the Detection of Target Constituents in A-Aquifer Groundwater Samples, 1984 to 1991

Target Constituent	Historic Frequency of Detection of Target Constituents in Groundwater Samples **												All **
	V-1	V-2	V-3	V-4	V-5	V-6	V-7	V-8	V-9	V-10	V-11	V-12	
1,1,1-TCA	1/21	12/12	6/21	34/34	0/13	4/13	20/21	13/15	1/10	1/11	0/4	0/4	92/179
1,1-DCA	15/21	11/12	16/21	34/34	0/13	0/13	21/21	1/15	10/10	0/11	0/4	0/4	108/179
1,1-DCE	2/21	5/12	3/21	33/34	0/13	0/13	17/21	1/15	0/10	0/11	0/4	0/4	61/179
1,2-DCA	0/21	2/11	1/21	3/32	0/13	0/13	0/21	0/16	0/10	0/11	0/4	0/4	6/176
1,3-Dichlorobenzene	0/2	2/11	0/19	0/10	0/3	0/3	0/3	0/2	0/1	0/2	0/0	0/0	2/56
Trans-1,2-DCE	2/21	2/11	6/21	0/30	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	10/169
4-Nitrophenol	1/19	0/3	0/18	0/20	0/9	0/9	0/8	0/4	0/4	0/4	0/0	0/0	1/97
Acetone	4/35	2/3	3/34	4/39	1/15	0/17	1/22	1/26	0/17	3/18	0/9	0/9	19/239
Benzene	0/21	2/7	1/22	0/31	0/13	1/13	0/22	0/15	0/10	0/11	0/4	0/4	4/173
Bromoform	0/20	0/11	0/21	1/31	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	1/173
Carbon Tetrachloride	0/20	0/11	0/21	0/31	0/13	0/13	1/20	0/15	0/10	0/11	0/4	0/4	1/173
Chlorobenzene	0/19	2/9	0/21	1/31	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	3/170
Chloroethane	1/20	5/11	0/21	25/31	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	31/173
Chloroform	0/20	0/11	0/21	0/31	0/13	0/13	1/21	0/15	0/10	0/11	0/4	0/4	1/173
Dibromochloro- methane	0/19	1/11	0/21	2/30	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	3/171
Ethanol	2/22	1/3	1/21	2/21	0/9	0/9	0/10	0/18	0/8	1/9	0/5	0/5	7/135
Ethylbenzene	0/20	2/6	0/21	0/28	0/13	0/13	0/20	0/15	0/10	0/10	0/4	0/4	2/164
Isopropanol	1/22	1/3	0/21	1/21	0/9	0/9	0/10	0/13	0/8	1/9	0/5	0/5	4/135
Methanol	3/22	0/3	3/21	2/21	0/9	0/9	0/10	0/13	1/8	0/9	0/5	0/5	9/135
Methyl Ethyl Ketone	1/4	3/7	0/4	0/6	0/3	0/3	0/3	0/1	0/1	0/0	0/0	0/0	7/32
Methylene Chloride	10/22	13/13	10/22	19/34	0/13	0/13	1/21	0/15	0/10	3/11	0/4	0/4	56/182
Pentachlorophenol	2/20	0/3	1/19	0/20	0/9	0/8	0/8	0/4	0/4	0/4	0/0	0/0	3/99
Phenol	0/19	0/3	0/18	1/20	0/9	0/8	0/8	0/4	0/4	0/4	0/0	0/0	1/97
Tetrachloroethene	0/20	2/11	0/21	0/30	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	2/172
Toluene	0/20	4/7	0/22	3/29	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	8/168
TPH as diesel	10/19	0/0	11/19	10/17	0/5	0/5	0/5	0/5	0/5	0/6	0/0	0/0	31/86
TPH as thinners	4/15	0/2	1/15	3/14	0/7	0/7	0/7	0/3	0/3	0/4	0/0	0/0	8/84
Trichloroethene	0/21	4/11	0/22	0/30	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	4/174
Vinyl Chloride	0/20	3/11	1/20	8/31	0/13	0/13	1/20	0/15	0/10	0/11	0/4	0/4	13/172
Xylene	0/21	5/7	2/20	0/27	0/13	0/13	0/20	0/15	0/10	0/11	0/4	0/4	7/164

\* - Ratio between number of samples in which constituent was detected at a level exceeding the analytical detection limit and the total number samples analyzed for the constituent.

\*\* - Includes results of analyses from all well locations.

10/16/91

Table 1.8  
Historic Frequency of the Detection of Target Constituents  
in B(1)-Aquifer Groundwater Samples, 1984 to 1991

Target Constituent	Frequency *			All **
	I-1	I-2	I-3	
1,1,1-TCA	3/18	13/16	0/12	16/46
1,1-DCA	7/18	13/16	0/12	20/46
1,1-DCE	0/18	8/16	0/12	8/46
Acetone	3/30	1/26	0/18	4/74
Methylene Chloride	1/19	0/16	0/12	1/47
Phenol	0/7	0/6	2/12	2/25
Vinyl Chloride	0/18	0/16	1/12	1/46

\* - Ratio between number of samples in which constituent was detected at a level exceeding the analytical detection limit and the total number samples analyzed for the constituent.

\*\* - Includes results of analyses from all well locations.

Table 1.9  
Results of Analyses of Discharge Water Samples  
Extraction Well V-4

Constituent	Jan 1990	Feb 1990	Feb 1990	Mar 1990	Mar 1990	Apr 1990	May 1990	June 1990	July 1990	Aug 1990	Sep 1990	Oct 1990	Nov 1990	Dec 1990
Chloroethane	nd	nd	0.015	0.012	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.036
Chloromethane	nd	nd	nd	nd	nd	nd	0.004	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.870	0.470	0.850	0.520	0.410	0.300	0.260	0.280	0.250	0.260	0.210	0.230	0.210	0.380
1,2-Dichloroethane	nd	nd	0.009	nd	nd	nd	0.003	nd	nd	nd	nd	nd	nd	0.003
1,1-Dichloroethene	0.085	0.048	0.060	0.040	0.048	0.033	0.022	0.035	0.036	0.035	0.023	0.022	0.013	0.033
Methylene Chloride	0.320	0.029	0.430	0.092	0.110	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.530	0.190	0.750	0.320	0.320	0.098	0.058	0.068	0.047	0.038	0.030	0.025	0.019	0.057
1,1,2-Trichloroethene	nd	nd	0.009	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	nd	nd	nd	0.010	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

All concentrations in mg/L

Table 1.10

**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS**

**JASCO Site  
Mountain View, California**

Statue or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
<b><u>Federal Requirements, Criteria, or Limitations</u></b>				
Safe Drinking Water Act	42 U.S.C. § 300f <u>et seq.</u> Pub. L 93-523	Goal of the Act is to protect human health by protecting the quality of drinking water. The Act authorizes establishment of drinking water standards.	Yes/No	Applies to CERCLA site discharges to public drinking water sources, including underground drinking water sources.
National Primary Drinking Water Standards	40 CFR Part 141	Establishes primary maximum contaminant levels (MCLs) that are health-based standards for public water systems.	Yes/No	MCLs are ARARs for any water that is considered a source or potential source of drinking water. MCLs are applicable at the tap when water is provided directly to 25 or more people or 15 or more service connections. Otherwise, MCLs are relevant and appropriate.
Maximum Contaminant Level Goals (MCLGs)	40 CFR 141, Subpart F	Establishes drinking water quality goals set at levels of no known or anticipated adverse health effects, with an adequate margin of safety.	No/Yes	MCLGs are not federally enforceable drinking water standards, but CERCLA § 121(d) has raised MCLGs and water quality criteria (see below) to the level of potentially relevant and appropriate. MCLGs may be considered when a CERCLA cleanup may require more stringent standards than the MCLs. EPA has established that the use of MCLGs will be decided on a case-by-case basis. MCLGs are relevant and appropriate when the chemical-specific goal is not zero.
Clean Water Act	33 U.S.C. § 1251-1376	Provides for the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters. Enabling statute for a system of minimum national standards for effluent discharge; a construction grant program for POTWs; ocean discharge requirements; and water quality	Yes/No	

Table 1.10

**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS  
JASCO SITE  
Mountain View, California**

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
		criteria.		
Water Quality Criteria	40 CFR Part 131 Quality Criteria for Water, 1976, 1980, 1986	Federal water quality criteria are guidelines from which states establish their water quality standards. Criteria are developed for the protection of human health and aquatic life.	No/Yes	Applicable to direct discharges to surface waters. An indirect discharge to a POTW may be considered an off-site activity even if the conveyance system is on site. A POTW may require a CERCLA wastewater to meet "pretreatment" standards prior to acceptance. If a water quality standard is available for a contaminant, that standard should be used rather than the criteria. Basin Plans established water quality standards in the states. Water quality criteria are relevant and appropriate when no standard exists.
National Pollutant Discharge Elimination System	40 CFR Part 122, 125	Requires permits for the discharge of pollutants from any point source into waters of the United States. The Act defines a point source as any discernable, confined, or discrete conveyance from which pollutants are or may be discharged. Effluent limitations must protect beneficial uses of water.	Yes/No	Substantive requirements apply to discharges to surface water bodies or to the local storm drain system. Pretreatment standards may have to be met for discharges to the POTW.
National Pretreatment Standards	40 CFR Part 403	Sets standards to control pollutants that pass through or interfere with treatment processes in publicly owned treatment works (POTW) or that may contaminate sewage sludge.	Yes/No	



Table 1.10

**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS  
JASCO SITE  
Mountain View, California**

Statue or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Clean Air Act	42 U.S.C. §§ 7401 <u>et seq.</u>	Regulates emissions to protect human health and the environment. Enabling statute for major provisions such as National Ambient Air Quality Standards, NESHAPs, NSPS.	No/Yes	Substantive requirements of the various programs (e.g., NESHAPs, NSPS) provided by the Clean Air Act are implemented primarily through the regional Air Pollution Control Districts for stationary sources. Applicable to remedial alternatives that may result in air emissions.
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes National Ambient Air Quality Standards (NAAQS) for the protection of public health and welfare.	No/Yes	Primary standards applicable to any alternative emitting regulated pollutants.
Solid Waste Disposal Act	42 U.S.C. §§ 6901-6987	This law has been amended by RCRA and HSWA.		
Hazardous Waste Management Systems General	40 CFR Part 260	Provides definitions of hazardous waste terms, procedures for rule-making petitions, and procedures for delisting a waste.	Yes/Yes	Definitions may be applicable or relevant and appropriate to various potential activities. May be applicable if variances or delisting is required.
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Yes/No	Applicable if the selected alternative involves generation and off-site transportation of hazardous waste.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (RCRA)	40 CFR Part 264	Establishes minimum national standards that define the acceptable management of hazardous waste for owners and operators of facilities that treat, store, or dispose of hazardous waste.	Yes/Yes	Any remedy that involves current treatment, storage, or disposal generally will be applicable. If the action does not involve current treatment, storage, or disposal, it may be relevant and appropriate.

Table 1.10

**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS  
JASCO SITE  
Mountain View, California**

Statue or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
General Facility Standards	40 CFR 264.10, <u>et seq.</u> Subpart B		Yes/Yes	Applicable to on-site treatment, storage, or disposal of hazardous waste. Location standards (i.e., setback from a Holocene fault and design, construction, operation, and maintenance standards relative to the 100-year flood) may be applicable for a new landfill.
Preparedness and Prevention	40 CFR 264.30, <u>et seq.</u> Subpart C		Yes/No	Applicable to on-site treatment, storage, or disposal of hazardous waste.
Contingency Plan and Emergency Procedures	40 CFR 264.50, <u>et seq.</u> Subpart D		Yes/No	Applicable to on-site treatment, storage, or disposal of hazardous waste.
Manifest System, Record-keeping, and Reporting	40 CFR 264.70, <u>et seq.</u> Subpart E		Yes/No	Applicable only if waste is transported for off-site treatment, storage, or disposal.
Releases from Solid Waste Management Units	40 CFR 264.90, <u>et seq.</u> Subpart F		Yes/No	Applicable if hazardous waste remains on site. The maximum contaminant concentrations that can be released from hazardous waste units are identical to the MCLs.
Closure and Post-Closure	40 CFR 264.110, <u>et seq.</u> Subpart G		Yes/No	Applicable if hazardous waste is treated or stored in a new on-site unit. Not applicable to consolidation within area of contamination or to in situ treatment.
Financial Requirements	40 CFR 264.140, <u>et seq.</u> Subpart H		Yes/No	Applicable for closure/post-closure of any treatment unit.
Use and Management of Containers	40 CFR 264.170, <u>et seq.</u> Subpart I		Yes/No	Applicable if alternative involves storage of hazardous waste in containers.

Table 1.10

**APPLICABLE OR RELEVANT  
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JASCO SITE  
Mountain View, California**

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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Tank Systems	40 CFR 264.190, <u>et seq.</u> Subpart J		No/No	Applicable if alternative involves treatment or storage of hazardous waste in tank system(s).
Surface Impoundments	40 CFR 264.220, <u>et seq.</u> Subpart K		No/No	No alternative is being considered that would use a surface impoundment.
Waste Piles	40 CFR 264.250, <u>et seq.</u> Subpart L		Yes/No	Applicable if alternative involves storage of hazardous waste in waste piles for more than 90 days.
Miscellaneous Units	40 CFR 264.600, <u>et seq.</u> Subpart X		Yes/No	Applicable if alternative involves on-site treatment in a miscellaneous unit.
Standards for the Management of Specific Hazardous Waste and Specific Types of Hazardous Waste Management Facilities	40 CFR Part 266	Establishes requirements that apply to recyclable materials that are reclaimed to recover economically significant amounts of precious metals, including gold and silver.	No/No	No alternative is being considered that would involve recycling or reusing hazardous waste.
Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities	40 CFR Part 267	Establishes minimum national standards that define acceptable management of hazardous waste for new land disposal facilities.	No/No	The selected alternative does not involve use of a new land disposal facility; 40 CFR Part 267 standards are not applicable.
Land Disposal Restrictions	40 CFR Part 268	Restricts the land disposal of hazardous waste and specifies treatment standards that must be met before these wastes can be land disposed.	Yes/No	Applicable if the selected alternative involves placement of waste from outside the area of contamination, if waste is removed, treated, and redeposited into the same or another unit. A treatability variance may also be applicable.

Table 1.10

**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS  
JASCO SITE  
Mountain View, California**

Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic EPA permitting requirements.	No/No	Permits are not required for on-site CERCLA response actions. Substantive requirements of 40 CFR 264 may be applicable.
Occupational Safety and Health Act	29 U.S.C. §§ 651-678	Regulates worker health and safety.	No/Yes	Applies to all response activities under the NCP. (Superseded by CAL-OSHA.)
Hazardous Material Transportation Act	49 U.S.C. §§ 1801-1813			
Hazardous Materials Transportation Regulations	49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	Yes/No	Applicable if waste is shipped off site.
National Historic Preservation Act	16 U.S.C. § 470 40 CFR 6.301(b) 36 CFR Part 800	Requires federal agencies to take into account the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object that is included in or eligible for the National Register of Historic Places.	No/No	No district, site, building, structure, or object will be affected that is included in or eligible for the National Register of Historic Places.
Archaeological and Historic Preservation Act	16 U.S.C. § 469 40 CFR 6.301(c)	Establishes procedures to provide for preservation of historical and archaeological data that might be destroyed through alteration of terrain as a result of a federal construction project or a federally licensed activity or program.	No/No	No historical or archaeological data will be affected.
Historic Sites, Buildings, Objects, and Antiquities	16 U.S.C. §§ 461-467 40 CFR 6.301(a)	Requires federal agencies to consider the existence and location of landmarks on the National Registry of Natural Landmarks to avoid undesirable impacts on such landmarks.	No/No	No natural landmarks will be affected.

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Fish and Wildlife Coordination Act	16 U.S.C. §§ 661-667	Requires consultation when federal department or agency proposes or authorizes any modification of any stream or other water body and requires adequate provision for protection of fish and wildlife resources.	No/No	
Endangered Species Act	16 U.S.C. 1531-1536 50 CFR Part 402	Requires action to conserve endangered species within critical habitats upon which endangered species depend; includes consultation with Department of Interior.	No/No	The clapper rail and salt marsh harvest mouse are endangered species that inhabit tidal lands in the South Bay. However, they have not been observed on the Jasco site and are not an issue for this site.
Clean Water Act	33 U.S.C. §§ 1251-1376			
Dredge or Fill Requirements (Section 404)	40 CFR Parts 230, 231	Requires permits for discharge of dredged or fill material into navigable waters.	No/No	There may be discharge of dredged or fill materials into navigable waters as part of remediation of the Wetland Operable Unit.
Protection of Navigable Waters and of Harbor and River Improvements Generally	33 U.S.C. § 403			
General Regulatory Policies - Department of the Army Corps of Engineers	33 CFR Parts 320-330	Requires permit for structures or work in or affecting navigable waters.	No/No	No activities in this operable unit will discharge dredged or fill materials into navigable waters of the U.S.
Executive Order, Protection of Wetlands	Exec. Order 11990  40 CFR §6.302(a) and Appendix A	Requires federal agencies to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practical alternative exists.	No/No	There are no wetland impacts associated with this site.

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**APPLICABLE OR RELEVANT  
AND APPROPRIATE REQUIREMENTS  
JASCO SITE  
Mountain View, California**

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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Executive Order, Floodplain Management	Exec. Order 11988	Requires federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid adverse impacts associated with direct and indirect development of a floodplain.	No/No	Site not located within a flood zone.
National Wilderness Preservation System	16 U.S.C. § 1131 50 CFR § 35.1	Establishes the national system of wilderness areas, including a policy for protecting and managing these areas. It prohibits certain activities within wilderness areas.	No/No	There are no wilderness areas on or adjacent to the site.
National Wildlife Refuge System Administration Act	16 U.S.C. § 668dd 50 CFR § 27	Restricts activities within a National Wildlife Refuge.	No/No	There are no wildlife refuge areas on or adjacent to the site.
Wild and Scenic Rivers Act	16 U.S.C. § 1271 40 CFR § 6.302(e)	Prohibits adverse effects on scenic rivers.	No/No	There are no designated wild or scenic rivers on or adjacent to the site.
<b><u>State Requirements, Criteria, or Limitations</u></b>				
Coastal Zone Management Act	16 U.S.C. § 1451	Governs activities in the coastal zone.	No/No	No activities in this operable unit will occur within the coastal zone.
Air Resources Act	Health & Safety Code, Div. 26, Sec. 39000 <u>et seq.</u>  17CCR, Part III, Chapter 1, Sec. 6000 <u>et seq.</u>	Regulates both non-vehicular and vehicular sources of air contaminants in California. Defines relationship of the California Air Resources Board (ARB) and local or regional air pollution control districts (APCDs). Establishes Ambient Air Quality Standards.	Yes/No	The Act is implemented primarily through the APCDs for stationary sources.

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Bay Area Management Pollution Control District Rules and Regulations	Pollution Control District Rules and Regulations	Rules and regulations pertain to stationary sources of air emissions. Rules address prohibition of visible emissions; incinerator standards; nuisance, and compliance with PSD, NESHAPs, NSPS, and ambient air emission standards.	Yes/No	Substantive requirements applicable to alternatives that have the potential to emit air pollutants.
Air Toxics "Hot Spots" Information and Assessment Act	Health & Safety Code, Chapter 1252 Stats 1987 Sec. 44300 <u>et seq.</u>	Requires operators of facilities emitting more than a specified level of pollutants to perform an assessment of those emissions. Certain facilities, as prioritized by the air district, will need to perform a risk assessment.	Yes/No	Substantive requirements applicable to alternatives that have the potential to emit air pollutants.
California Safe Drinking Water Act	Health & Safety Code, Div. 5, Part 1, Chapter 7, Sec. 4010 <u>et seq.</u>	Regulations governing public water systems; provides for drinking water quality standards - Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs).	No/Yes	MCLs are acceptable concentration limits from a "free flowing cold water outlet of the ultimate user." To apply this standard as a cleanup level for groundwater means that the law, and the standard, is "relevant and appropriate."
	22 CCR, Div. 4, Chapter 15, Sec. 64401 <u>et seq.</u>	Establishes primary and secondary drinking water standards for public water systems.		
Porter Cologne Water Quality Control Act	Water Code, Div. 7, Sec. 13000 <u>et seq.</u>	Identifies general duties and authorities of state and regional water boards, including preparation of a Basin Plan and enforcement of water quality regulations.	Yes/No	The San Francisco Bay Regional Water Quality Control Board will be involved in setting cleanup goals for contaminated soil and groundwater and for establishing acceptable conditions for reinjection. The Region 2 Basin Plan includes limitations on surface water discharges. It adopts State Board Resolutions 68-16, which applies to maintaining water quality; 88-63, which sets criteria for groundwater to be considered a drinking water

Table 1.10

**APPLICABLE OR RELEVANT  
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JASCO SITE  
Mountain View, California**

Statue or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
	<u>23 CCR, Div. 3:</u>			source; and Regional Board Resolution 88-160, which applies to disposal of extracted groundwater from groundwater remediation projects.
	- Chapter 9, Sec. 2200 <u>et seq.</u>	Waste Discharge Reports and Requirements.	Yes/Yes	Substantive requirements may apply.
	- Chapter 9.1, Sec. 2240 <u>et seq.</u>	Enforcement Procedures for Cease and Desist Orders.	No/No	These are administrative requirements, not ARARs.
	- Chapter 10, Sec. 2300 <u>et seq.</u>	Licensing and Regulation of Use of Oil Spill Cleanup Agents	No/No	Oil spill cleanup agents are not part of potential alternatives.
	- Chapter 15, Sec. 2510 <u>et seq.</u>	Discharge of Waste to Land. Regulations establishing waste and site classifications and waste management requirements for waste treatment, storage, or disposal in landfills, surface impoundments, waste piles, and land treatment facilities.	Yes/Yes	Substantive requirements may be applicable or relevant and appropriate if alternative involves use of new landfill. No alternatives involve the use of new landfills.
	- Chapter 16, Sec. 2610 <u>et seq.</u>	Underground Tank Regulations. New and existing UST construction, monitoring, repairs, releases of substances, and closure.	Yes/No	There are underground tanks that will be removed in the future and remediation of that area will occur.
Water Well Standards, State of California	Bulletin 74-81	The standards are intended to apply to the construction and major reconstruction or destruction of water wells.	Yes/No	Well construction, abandonment, and destruction will comply with these standards.
California Hazardous Waste Control Laws	Health & Safety Code, Div. 20,	Regulations governing hazardous waste control; management and control of hazardous	Yes/Yes	



Table 1.10

**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
	Chapter 65, Sec. 25100, <u>et seq.</u>	waste facilities; transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste.		
	22 CCR, Div. 4 Chapter 30, Sec. 66001 <u>et seq.</u>	Minimum standards for management of hazardous and extremely hazardous waste.	Yes/Yes	
Safe Drinking Water & Toxics Enforcement Act of 1986 ("Proposition 65")	Health & Safety Code, Div. 20, Chapter 6.6, Sec. 26249.5 <u>et seq.</u>	Provides protection of drinking water by prohibiting any detectable discharge of certain listed carcinogens and reproductive toxicants. Requires warnings to be given when any exposure to the chemicals (regulated under the Act) is anticipated.	No/No	Provisions apply only to certain listed chemicals and to persons in the course of doing business. Additionally, the treated water is returned to the same source or water supply.
California Hazardous Substance Account Act/Hazardous Substances Cleanup Bond Act	Health & Safety Code, Div. 20, Chapter 6.8, Sec. 25300 <u>et seq.</u>	Establishes a program to provide for response authority for releases of hazardous substances; compensation for injuries resulting from exposure to release of hazardous substances; and adequate matching funds for CERCLA actions.	Yes/No	
Hazardous Materials Release Plans and Inventory Requirements	Health & Safety Code, Div. 20, Chapter 6.95, Sec. 25500 <u>et seq.</u>  19 CCR, Chapter 2, Subchapter 3, Sec. 2620 <u>et seq.</u>	Reporting requirements for a release or threatened release of a hazardous material. Sets requirements for "Area Plans"; "Business Plans"; the Acutely Hazardous Materials Registration form; and the Risk Management and Prevention Program.	No/No	Not an ARAR for CERCLA activities.

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
Environmental Quality Assessment Requirements	Health & Safety Code, Div. 20, Chapter 6.98, Sec. 25570 <u>et seq.</u>	Requirements and procedures for preparation of environmental quality assessments (environmental audits).	No/No	Not an ARAR for CERCLA activities.
Hazardous Substances Act	Health & Safety Code, Div. 22, Chapter 13, Sec. 28740 <u>et seq.</u>	Provides definitions of "hazardous substance" and "toxic."	Yes/No	Applicable to hazardous substances identified in the code.
California Environmental Quality Act (CEQA)	Pub.Res. Code, Div. 13  14 CCR, Div. 6, Sec. 15000 <u>et seq.</u>	Provides for the environmental review of discretionary actions.  Guidelines for implementation of CEQA, including responsibilities of public agencies, lead agencies, initial studies, negative declaration declaration process, EIR process, time limits, contents, review, and approval.	No/No	The RWQCB is categorically exempt from preparing EIRs for remediation projects.
Fish and Game Regulations on Pollution	Fish and Game Code, Div. 6, Part 1, Chapter 2, Sec. 5650 <u>et seq.</u>	Codifies the prohibition of water pollution with any substance or material deleterious to fish, plant life, or bird life.	No/No	
California Highway Patrol Hazardous Material	Cal. Vehicle Code § 32000 <u>et seq.</u> ; 13 CCR § 1160 <u>et seq.</u>		Yes/No	May be applicable to transportation of hazardous materials from the site.
Hazardous Waste Movement Committee Memorandum of Understanding	An agreement made on November 8, 1983, by the DHS, Caltrans, and CHP	An agreement between the Departments of Health Services, Transportation (Caltrans), and California Highway Patrol to coordinate with each other for the transportation of large quantities of hazardous wastes excavated from	No/No	If selected alternative involves off-site transport of large quantities of hazardous waste, may have to be complied with. Not an ARAR because it applies to off-site activities.

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
		abandoned sites.		
California Occupational Health and Safety Act	Labor Code, Div. 5, Sec. 6300 <u>et seq.</u>	Regulations to assure safe and healthy working conditions by authorizing the enforcement of standards and procedures.	Yes/No	Worker health and safety is regulated primarily by CAI-OSHA, which generally supercedes federal OSHA.
	8 CCR, Chapter 4: Subchapter 4, Sec. 1500 <u>et seq.</u>	A detailed analysis of construction safety regulations.		
	Subchapter 5, Sec. 2300 <u>et seq.</u>	A detailed analysis of electrical safety regulations.		
	Subchapter 7, Sec. 3200 <u>et seq.</u>	A detailed analysis of general industrial safety regulations, including procedures, equipment, and structures.		
Criteria for Identification of Hazardous and Extremely Hazardous Wastes Threshold Limit Concentrations	22 CCR, Div. 4, Chapter 30, Art. 11, Sec. 66693-66747	Promulgated criteria to evaluate whether a material is hazardous. Includes Soluble Threshold Limit Concentration (STLC) and Total Threshold Limit Concentration (TTLC).	Yes/No	STCL and TTLC chemical-specific values reflect the chemical characteristics of persistence and bioaccumulation. The limits are not health-based.
Water Quality Objectives	RWQCB Criteria	Promulgated criteria setting chemical-specific concentration levels for a variety of uses of specific bodies of water. Based on the beneficial uses of specified water bodies.	Yes/No	Regional Water Quality Control Objectives are identified in the Water Quality Control Plan Reports (Basin Plans) of the nine Regional Water Quality Control Boards. May be applicable if groundwater is reinjected.
Underground Storage of Hazardous Substances Requirements	Health & Safety Code, Div. 20, Chapter 6.7, Sec.	Regulations governing the testing, monitoring, and replacing of underground storage tanks.	Yes/No	Underground tanks will be removed in the future and the area remediated. No tanks will be installed.

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
	25280 <u>et seq.</u>			
California Coastal Act of 1976	Pub. Res. Code, Div. 20, Sec. 30000 <u>et seq.</u>	Governs activities in the coastal zone.	No/No	No activities will be performed in the coastal zone in this operable unit.
McAteer-Petris Act of 1969 (BCDC)	Title 14 Administrative Code, Sec. 66600 <u>et seq.</u>	Provides permit authority over any construction within 100 feet of tidal waters of San Francisco Bay and in tidal waters.	No/No	Does not apply to the upland operable unit. Will be an ARAR for the wetland operable unit.
<b><u>Federal and State Criteria, Advisories, and Guidance to be considered</u></b>				
National Secondary Drinking Water Standards	40 CFR Part 143	Secondary maximum contaminant levels (SMCLs). Standard to control chemicals in drinking water that primarily affects the aesthetic qualities relating to public acceptance of drinking water.		Secondary standards are not federally enforceable; intended as guidelines for the states. SMCLs are not ARARs unless promulgated by state.
National Secondary Drinking Water Standards	40 CFR Part 143	Secondary maximum contaminant levels (SMCLs). Standard to control chemicals in drinking water that primarily affects the aesthetic qualities relating to public acceptance of drinking water.		Secondary standards are not federally enforceable; intended as guidelines for the states. SMCLs are not ARARs unless promulgated by state.
National Maximum Contaminant Level Goals	Pub. L. 99-339, 100 Stat. 642 (1986)	Establishes drinking water quality goals (MCLGs), at levels of no known or anticipated adverse health effects with an adequate margin of safety. MCLGs do not take cost or feasibility into account. Under SDWA, MCLGs are goals, not enforceable standards.		
Water Quality Standards	40 CFR Part 131	Nonenforceable criteria for water quality to protect human health and aquatic life. From the water quality criteria, states adopt water quality standards that protect a designated		CERCLA requires that the remedy selected must require a level or standard of control that at least attains water quality criteria established under Section 304 or 303 of the Clean Water

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**APPLICABLE OR RELEVANT  
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Statute or Regulation	Citation	Description	Applicable/ Relevant and Appropriate	Comments
		use. A water quality standard defines the water quality goals of a water body through use of designations and criteria to protect the designated uses.		Act. CERCLA also states "in determining whether or not any water quality criteria...is relevant and appropriate...the President shall consider the designated or potential use of the surface or ground water, the environmental media affected, the purposes for which the criteria were developed, and the latest information available."
Media Cleanup Standards (MCSs) (proposed)	55 FR 30798 Sec. 264.525	Proposed amendment to RCRA regulations. MCSs are established at concentrations that ensure protection of human health and the environment. Standards are set for each medium during the remedy selection process.		The regulations are proposed and therefore TBCs. When promulgated, the standards are potential ARARs.
<b><u>Other Potential Federal and State Criteria, Advisories, and Guidance to be Considered</u></b>				
Health Advisories	EPA and National Academy of Sciences	Health advisories developed for short-term, long-term, and lifetime exposures. The advisories are considered to be guidance and are not enforceable.		
Corrective Action for Solid Waste Management at Hazardous Waste Management Facilities	40 CFR 264.500 - 264.560, Subpart S (proposed)	Proposed rule establishes procedures and technical requirements for implementing corrective action under Section 3004(u) of RCRA. The regulations define requirements for conducting remedial investigations, evaluating potential remedies, and selecting and implementing remedies at RCRA facilities.		Provisions of the proposed rule (e.g., media cleanup standards, conditional remedies) must be addressed as TBCs.
Site-Specific Health-Based Goals	(PRC, 1992)	Conservative concentration goals for carcinogens and non-carcinogens in soil.		

**TABLE 1.11**  
**STANDARDS, PROPOSED STANDARDS AND ACTION LEVELS**  
**DRINKING WATER SOURCES**  
**CALIFORNIA AND FEDERAL REGULATIONS**

Constituent	STATE		FEDERAL				
	MCL (1) (mg/l)	AAL (2) (mg/l)	MCL (3) (mg/l)	Proposed MCL (3) (mg/l)	Proposed SMCL (4) (mg/l)	MCLG (5) (mg/l)	Proposed MCLG (5) (mg/l)
Benzene	0.001	0.0002	0.005	-	-	-	-
Carbon Tetrachloride	0.0005	-	0.005	-	-	-	-
Chloroform	-	0.006	-	-	-	-	-
1,1-Dichloroethane	0.005	-	-	-	-	-	-
1,2-Dichloroethane	0.0005	-	0.005	-	-	-	-
1,1-Dichloroethylene	0.006	-	0.007	-	-	-	-
Ethylbenzene	0.68	2.0	0.7	-	0.30	0.7	-
Methyl Ethyl Ketone	-	2.0	-	-	-	-	-
Methylene Chloride	-	-	-	0.005	-	-	-
Pentachlorophenol	-	0.002	-	0.001	0.03	-	0.0
Tetrachloroethylene	0.005	-	0.005	-	-	0.0	-
Toluene	-	2.0	1.0	-	0.04	1.0	-
1,1,1-Trichloroethane	0.2	0.3	0.2	-	-	-	-
Trichloroethylene	0.005	0.007	0.005	-	-	-	-
Vinyl Chloride	0.0005	0.0005	0.002	-	-	-	-
Xylenes	1.75	2.0	10.0	-	0.02	10.0	-

(1) Maximum Contaminant Level for Primary Drinking Water Sources (22 CCR 644)

(2) Applied Action Levels for risk appraisal, California Dept. of Health Services, 1989

(3) Maximum Contaminant Level - Safe Drinking Water Act (42 U.S.C. Pub. L. 93-523)

(4) Proposed Secondary Maximum Contaminant Level - Safe Drinking Water Act (42 U.S.C. Pub. L. 93-52  
Safe Drinking Water Act (42 U.S.C. Pub. L. 93-523)

(5) Maximum Contaminant Level Goal (40 CFR 141, Subpart F)

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**TABLE 2.1**  
**SOIL REMEDIATION GOALS FOR KEY CONSTITUENTS**

KEY CONSTITUENT	REMEDIATION LEVEL
<u>Known or Possible Carcinogens</u>	
Benzene	1 mg/kg
1,1-Dichloroethane	1 mg/kg
1,2-Dichloroethane	1 mg/kg
1,1-Dichloroethene	1 mg/kg
Methylene Chloride	1 mg/kg
Tetrachlorethene	1 mg/kg
Trichloroethane	1 mg/kg
Vinyl Chloride	0.5 mg/kg
Sum of All Compounds Detected	5 mg/kg
<u>Non-Carcinogens</u>	
1,1,1-Trichloroethane	50 mg/kg
Petroleum Hydrocarbons	50 mg/kg
Sum of All Compounds Detected	100 mg/kg

Source: Recommended Site-Specific Remediation Levels For Soils at the Jasco Chemical Corporation Site, Mountain View, California. Prepared by OHM Remediation Services, February 27, 1991. (Included as Appendix C)

10-15-91

**TABLE 2.2**  
**GROUNDWATER RESTORATION GOALS FOR KEY CONSTITUENTS**

<u>Key Constituent</u>	<u>Remediation Level (mg/l)</u>	<u>Max. Conc. Nov, 1991 (mg/l)</u>	<u>Max. Conc. in 1991 (mg/l)</u>
1,1-Dichloroethane	0.005 (1)	0.65	0.65
1,1-Dichloroethene	0.006 (1)	0.027	0.038
1,1,1-Trichlorethane	0.2 (1,2)	0.094	0.094
Methylene Chloride	0.005 (3)	0.15	0.15
Vinyl Chloride	0.0005 (1)	<0.002	0.0064

- (1) maximum contaminant levels for primary drinking water constituents as regulated under Title 22, California Code of Regulations, section 64444.5
- (2) maximum contaminant levels for primary drinking water constituents as regulated under 40 CFR 141 and 143
- (2) proposed maximum contaminant levels for primary drinking water constituents as regulated under 40 CFR 141 and 143



12/10/87

Table 2.3  
General Response Actions for Soil and Groundwater

<u>GENERAL SCREENING ACTIONS</u>	<u>MEDIA</u>	<u>DESCRIPTIONS</u>	<u>COMMENTS</u>	<u>STATUS</u>
No Action	Ground Water	No action; groundwater extraction and discharge would be stopped	Mandatory consideration per EPA guidance document	Retained
	Soil	No action per EPA guidance document	Mandatory consideration	Retained
Institutional Actions	Ground Water	Restrictions applied pertaining to site usage; use of alternate	Potentially applicable to protect potential receptors water supplies	Retained
	Soil	Land use restrictions protect potential receptors	Potentially applicable to	Retained
Collection	Ground Water	Extraction of ground water prior to treatment and/or disposal treatment	Potentially applicable; currently in use at the site without additional	Retained
	Soil	Extraction of soil vapors prior to treatment and/or disposal	Potentially applicable	Retained
Containment	Ground Water	The impediment of ground water flow to control the migration of contaminants	Potentially applicable in retarding down-gradient flow	Retained
	Soil	The encapsulation of contaminated media to control the migration of contaminants	Potentially applicable to minimizing migration of contaminants	Retained
Diversión	Ground Water	The deflection of ground water flow away from areas of contamination for preventing down-gradient flow	Not effective for remediation of shallow A-zone groundwater or	Not applicable
Excavation	Ground Water	Partial excavation and recovery of identified contamination established by the regulatory agencies	Alone, may not achieve remediation goals for groundwater	Not applicable
Excavation	Soil	Partial excavation and recovery of identified source area contaminated soil	Potentially effective by removing heavily	Retained

**Table 2.3**  
**General Response Actions for Soil and Groundwater**

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<b><u>GENERAL SCREENING ACTIONS</u></b>	<b><u>MEDIA</u></b>	<b><u>DESCRIPTIONS</u></b>	<b><u>COMMENTS</u></b>	<b><u>STATUS</u></b>
<b>On-Site Treatment</b>	Ground Water	Biological, physical, and/or chemical treatment applied to contaminated groundwater	Potentially effective in reducing concentrations of organics present in the groundwater	Retained
	Soil	Biological, physical, thermal, and/or chemical treatment applied to contaminated soil	Potentially effective in reducing concentrations of organics present in the soil	Retained
<b>In-situ Treatment</b>	Ground Water	Biological treatment applied to contaminated groundwater while still in place.	Potentially effective in reducing organics concentrations	Retained
	Soil	Biological, physical, thermal treatment and/or vitrification applied to contaminated soil while still in place	Potentially effective in reducing organics concentrations	Retained
<b>Off-Site Discharge</b>	Ground Water	Extracted ground water discharged to local POTW of organics	Potentially effective in reducing concentrations	Retained
	Soil	Excavated soil treated and/or disposed of at RCRA facility; disposal at RCRA facility is discouraged by SARA (1986)	Potentially effective in reducing concentrations of organics	Retained
<b>On-Site Discharge</b>	Ground Water	Extracted ground water treated and discharged on-site via NPDES permit or injection wells	Potentially effective in reducing concentrations of organics; discharge via NPDES permit needed	Retained
<b>Relocation</b>	Ground Water and Soil	Reimbursement of buildings and land costs impacted by organics contaminated ground water and soil to public receptors; includes relocation costs	No complete exposure pathways present at the site	Not applicable

Table 2.4: Initial Screening of Technologies and Process Options for Groundwater

<b>General Response Actions</b>	<b>Remedial Technology</b>	<b>Process Options</b>	<b>Description</b>	<b>Screening Comments</b>
No Action	None	Not applicable	No action	Required for consideration
Institutional Actions	Access restrictions	Deed restrictions	Deeds for property would include restrictions on wells	Potentially applicable
	Alternate water supply	City water supply	Connect affected residents to municipal water system	Not applicable, residents now served by municipal water system
	Monitoring	Ground water monitoring	On-going monitoring of wells	Potentially applicable
Collection	Extraction	Ground water recovery	Series of wells to extract contaminated ground water	Potentially applicable, one well already in place
Containment	Cap	Clay and soil cap	Compacted clay covered with soil over areas of contamination	Potentially applicable
	Vertical barrier	Slurry wall	Trench around contaminated area is filled with a soil (or cement) bentonite slurry	Potentially applicable
	Vertical barrier	Grout curtain	Pressure injection of grout in a ground through boreholes	Potentially applicable
	Horizontal barrier	Grout injection	Pressure injection of grout at depth	Not applicable, will not stop lateral migration of contaminants
On-site Treatment	Biological Treatment	Aerobic	Biological degradation of organic contaminants using microorganisms in an aerobic environment in a bioreactor	Potentially applicable
	Biological Treatment	Anaerobic	Biological degradation of organic contaminants using microorganisms in an anaerobic environment in a bioreactor	Potentially applicable
	Physical Treatment	Carbon Adsorption	Adsorption of contaminants onto activated carbon	Potentially applicable
	Physical Treatment	Resin Adsorption	Adsorption of contaminants onto synthetic adsorbents	Potentially applicable
	Physical Treatment	Coagulation/Flocculation	Fine suspended particulates are formed into larger settleable particles	Not applicable, no suspended contaminants
	Physical Treatment	Steam Stripping	Organics are removed by contact with steam and recovery of vapors	Potentially applicable

Table 2.4: Initial Screening of Technologies and Process Options for Groundwater

<b>General Response Actions</b>	<b>Remedial Technology</b>	<b>Process Options</b>	<b>Description</b>	<b>Screening Comments</b>
<b>On-site Treatment</b>	Physical Treatment	Filtration	Suspended contaminants are trapped as influent is forced through a filter media	Not applicable, no suspended contaminants
	Physical Treatment	Reverse Osmosis	Separation of contaminants via application of pressure gradient across a semi-permeable membrane	Not applicable for low molecular weight VOCs present at Jasco
	Physical Treatment	Air Stripping	Transfer of VOCs from aqueous stream into a gas stream	Potentially applicable
	Chemical Treatment	Dechlorination	Reaction to remove chlorine atom(s) from chlorinated VOCs to form alkali metal salt and a substituted organic polymer	Not applicable for chlorinated compounds on-site
	Chemical Treatment	Neutralization	Chemical adjustment of pH	Not applicable for VOCs
	Chemical Treatment	Solvent extraction	Contaminants are extracted by contacting it with another immiscible liquid, usually a solvent	Not appropriate for dilute mixture of contaminants
	Chemical Treatment	UV Peroxidation	Chemical bonds are broken to from CO <sub>2</sub> and H <sub>2</sub> O using ultra-violet light and a strong oxidizer such as ozone or H <sub>2</sub> O <sub>2</sub>	Potentially applicable
	Chemical Treatment	Supercritical water oxidation	The properties of supercritical water bring about rapid oxidation of organics and precipitation of inorganics	Potentially applicable
	Biological Treatment	Aerobic	Injection of nutrients and/or microorganisms to enhance biological degradation	Potentially applicable
	Biological Treatment	Anaerobic	Biological degradation of contaminants in an anaerobic environment	Potentially applicable
<b>Discharge</b>	Off-site discharge	POTW	Extracted ground water is discharged to local POTW for treatment	Potentially applicable
	On-site discharge	NPDES	Groundwater is treated and discharged to storm sewer	Potentially applicable
	On-site discharge	Injection wells	Re-inject treated water into water bearing zone	Not applicable

Table 2.5: Initial Screening of Technologies and Process Options for Soil

<u>General Response Actions</u>	<u>Remedial Technology</u>	<u>Process Option</u>	<u>Description</u>	<u>Screening Comments</u>
No Action	None	Not applicable	No action	Required for consideration
Institutional Actions	Access restrictions	Deed restrictions	Deeds for property would include restrictions on soil usage	Potentially applicable
	Monitoring	Vadose monitoring	Monitoring of vadose zone soil gases	Potentially applicable
Collection	Extraction	Vapor extraction	Series of wells to extract contaminated soil vapor	Potentially applicable
Containment	Cap	Asphalt cap	Capping soil with asphaltic concrete	Potentially applicable
	Liner	Clay liner	Treating soil to an appropriate level and then replacing in a lined area to reduce leachate potential	Potentially applicable
Excavation	Excavation and Underground Tank Removal	Physically removing source area	Defined areas of contaminated soil and other potential sources, such as tanks, excavated	Potentially applicable
On-site Treatment	Biological Treatment	Aerobic	Aerobic biological degradation of organic compounds using microorganisms in a bioreactor	Potentially applicable
		Enhanced Aerobic Biological Treatment	Aerobic biological treatment with aeration provided by vapor extraction	Potentially applicable
		Anaerobic	Anaerobic biological degradation of organic compounds using microorganisms in a bioreactor	Potentially applicable
	Physical Treatment	Soil Washing	Extraction of contaminants by washing soil with an appropriate solvent	Potentially applicable
	Physical Treatment	Carbon Adsorption	Adsorption of contaminants onto activated carbon	Not applicable; method is used for water treatment
	Physical Treatment	Resin Adsorption	Adsorption of contaminants onto synthetic adsorbents	Not applicable; method is used for water treatment
	Physical Treatment	Desorption	Contaminants separated by heating soil	Potentially applicable
	Physical Treatment	Heated stripping	Transfer of VOCs from soil into a hot gas stream	Potentially applicable

Table 2.5: Initial Screening of Technologies and Process Options for Soil

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<u>General Response Actions</u>	<u>Remedial Technology</u>	<u>Process Option</u>	<u>Description</u>	<u>Screening Comments</u>
On-site Treatment	Chemical Treatment	Dechlorination	Reaction to remove chlorine atom(s) from chlorinated VOCs to form alkali metal salt and a substituted organic polymer	Not applicable for contaminants at Jasco, process designed for PCBs and dioxins.
	Chemical Treatment	Neutralization	Chemical adjustment of pH	Not applicable for VOCs
	Thermal Treatment	Incineration	Contaminated soil are exposed to extreme heat to destroy the contaminants	Not applicable; an incinerator would not acceptable to the local citizens or government
In-situ Treatment	Biological Treatment	Aerobic	Injection of nutrients and/or microorganisms into media to enhance biological degradation in place	Potentially applicable
	Solidification	Vitrification	Soil is melted at extremely high temperatures to form glass; contaminants are destroyed and/or immobilized within the glass matrix	Potentially applicable
Discharge	Off-site discharge	RCRA Facility	Contaminated soil transported to RCRA facility for treatment and disposal	Potentially applicable

Table 2.6: Selection of Representative Groundwater Remedial Options

<b>General Response Actions</b>	<b>Remedial Technology</b>	<b>Process Options</b>	<b>Effectiveness</b>	<b>Implementability</b>	<b>Cost</b>	<b>Retained for Remedial Alternatives</b>
No Action	None	Not applicable	Will not achieve remedial action objectives	Implementable, not acceptable to public or local government	None	Yes
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on future enforcement of restrictions	Implementable, legal requirements	Low capital	Yes
	Monitoring	Ground water monitoring	Effective in determining migration of contaminants	Implementable, already in place	Low to moderate capital, high O&M	Yes
Collection	Extraction	Ground water extraction	Effective, may need to be treated prior to discharge	Implementable, already in place with no other treatment	Low to moderate capital, moderate O&M	Yes
Containment	Cap	Clay and Soil Cap	Not effective for remediation; can be used to prevent further contamination prior to remedial action	Implementable	Low to moderate capital, low to moderate O&M	No
	Vertical Barrier	Slurry Wall	Limited effectiveness, long-term effectiveness not proven	Difficult to implement, must be tied to aquitard	Extremely high capital, low O&M	No
	Vertical Barrier	Grout Curtain	Limited effectiveness, long-term effectiveness not proven	Difficult to implement, must be tied to aquitard	Extremely high capital, low O&M	No
On-site Treatment	Biological Treatment	Aerobic	Effectiveness to be determined for chlorinated compounds	Implementability to be determined	Low to moderate capital, moderate O&M	Yes
	Biological Treatment	Anaerobic	Effective for select chlorinated compounds. Used in line with aerobic treatment	Implementability to be determined	Low to moderate capital, low to moderate O&M	Yes

Table 2.6: Selection of Representative Groundwater Remedial Options

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General Response Actions	Remedial Technology	Process Options	Effectiveness	Implementability	Cost	Retained for Remedial Alternatives
On-site Treatment	Physical Treatment	Carbon Adsorption	Effective in reducing concentration of contaminants	Implementable	Moderate capital, moderate O&M	Yes
	Physical Treatment	Resin Adsorption	Effective in reducing concentration of contaminants	Implementable	Moderate capital, moderate O&M	No
	Physical Treatment	Steam Stripping	Effective in reducing concentration of contaminants	Implementable	Moderate capital, high O&M	No
	Physical Treatment	Air Stripping	Effective in reducing concentrations of contaminants. Air may need to be treated.	Implementable	Moderate capital, moderate O&M	Yes
	Chemical Treatment	UV Peroxidation	Effective in destroying contaminants	Implementable	Low to moderate capital, low to moderate O&M	Yes
	Chemical/Physical Treatment	Supercritical water oxidation	Effective in destroying organic compounds	Implementable	High capital, high O&M	No
In situ Treatment	Biological	Aerobic	To be determined	To be determined	To be determined	Yes
	Biological	Anaerobic	To be determined	To be determined	To be determined	Yes
Discharge	Off-site discharge	POTW	Effective in removing contaminated ground water from the aquifer. Treatment is left to city sewage treatment facility.	Implementable, already in place. Concentrations of contaminants must be monitored and remain below permitted level.	Low to moderate capital, low O&M	Yes
	On-site discharge	NPDES	Effective in removing contaminated ground water from the aquifer.	Implementable, permit required.	Moderate to high for laboratory analysis	No



Table 2.7: Selection of Representative Soil Remedial Options

<u>General Response Actions</u>	<u>Remedial Technology</u>	<u>Process Option</u>	<u>Effectiveness</u>	<u>Implementability</u>	<u>Cost</u>	<u>Retained for Remedial Alternatives</u>
No Action	None	Not applicable	Does not achieve remedial action objectives	Not acceptable to public or government	None	Yes
Institutional Actions	Access restrictions	Deed restrictions	Effectiveness depends on continued future implementation. Does not reduce contamination	Legal requirements and authority	Negligible cost	Yes
	Monitoring	Vadose monitoring	Useful for documenting conditions. Does not reduce contamination.	Alone, not acceptable to public or government	Low capital, low O&M	Yes
Collection	Extraction	Vapor extraction	Effective for VOC's; not effective for non- and semi-volatile	Implementable	Low to moderate capital, moderate O&M	Yes
Containment	Cap	Asphalt cap	Effective, but susceptible to cracking	Implementable	Low to moderate capital, high O&M	Yes
	Liner	Clay liner	Effective, but susceptible to cracking	Implementable	Low to moderate capital, moderate O&M	Yes
Excavation	Excavation	Excavate known areas of contamination	Effective in removing contamination sources	Implementable	Moderate to high capital, no O&M	Yes

Table 2.7: Selection of Representative Soil Remedial Options

<u>General Response Actions</u>	<u>Remedial Technology</u>	<u>Process Option</u>	<u>Effectiveness</u>	<u>Implementability</u>	<u>Cost</u>	<u>Retained for Remedial Alternatives</u>
On-site Treatment	Biological Treatment	Aerobic	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	No
		Enhanced aerobic biological treatment	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	Yes
		Anaerobic	Effectiveness to be determined for chlorinated VOCs	Implementable	Low to moderate capital, low O&M	Yes
On-site Treatment	Physical Treatment	Excalibur Soil Washing Process	Effectiveness needs to be evaluated in treatability study	Implementable	To be determined	Yes
	Physical Treatment	Desorption	Effective for VOC's; less effective for non- and semi-volatiles	Implementable	High capital, high O&M	No
	Physical Treatment	Heated Stripping	Effective in reducing concentration of contaminants	Implementable	Moderate to high capital; moderate to high O&M	No
In situ Treatment	Biological	Aerobic	To be determined	To be determined	To be determined	Yes
	Biological	Anaerobic	To be determined	To be determined	To be determined	Yes
	Solidification	Vitrification	Effective in thermally destroying or immobilizing contaminants	Not implementable; possibility in damaging nearby railroad tracks	High capital	No
Discharge	Off-site discharge	RCRA Facility	Effective for disposal of hazardous waste	Implementable, Jasco still liable for future liability	High capital	Yes

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**Table 2.8**  
**Analytical Requirements Under NPDES Permit**

<u>Analysis</u>	<u>Frequency</u>	<u>Cost per Sample</u>
96-hour Bioassay	Biannual	\$600
Metals (As,Ag,Cr, Cd, Cu, Hg, Ni, Pb, Se, Zn)	Monthly	\$225
EPA Method 601/602	Monthly	\$125
EPA Method 8015	Monthly	\$200
EPA Method 625	Biannual	\$500

TABLE 3.1 EVALUATION OF FINAL GROUNDWATER ALTERNATIVES

<u>Criteria</u>	<u>Alternative I</u> <u>No Action</u>	<u>Alternative II</u> <u>Discharge to POTW</u>	<u>Alternative III</u> <u>UV Oxidation</u>	<u>Alternative IV</u> <u>Carbon Adsorption</u>	<u>Alternative V</u> <u>Air Stripping</u>	<u>Alternative VI</u> <u>Biological Treatment</u> <u>w/Carbon Adsorption</u>
<u>OVERALL PROTECTIVENESS</u>						
Human Health Protection - Groundwater Ingestion	No current groundwater users, no reduction for future users.	No existing users of groundwater, will reduce risk for future users.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Protection	Allows continued contamination of groundwater.	Continued contamination is curbed by capturing plumes of contamination; will provide treatment for current contamination.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
<u>COMPLIANCE WITH ARARs</u>						
- Chemical Specific ARARs	Does not comply with ARARs.	Treated water will comply ARARs; groundwater within aquifer may not comply with ARARs.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
<u>LONG-TERM EFFECTIVENESS AND PERMANENCE</u>						
Magnitude of Residual Risk - Groundwater Ingestion	Future risk may increase as contaminants migrate further.	Future risk will be reduced as contaminated groundwater is treated.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Adequacy and Reliability of Controls	No controls over remaining contamination.  No reliability.	Extraction wells will be designed to control migration of groundwater plume.  Reliable, this system has been in use since 1987.	See Alternative II.  Process is relatively simple, but equipment problems will have to be serviced by vendor.	See Alternative II.  Reliable process. Effluent needs to be monitored for breakthrough.	See Alternative II.  Reliable process. Air and water effluent will need to be monitored for breakthrough.	See Alternative II.  May need treatability study to optimize process.

TABLE 3.1 EVALUATION OF FINAL GROUNDWATER ALTERNATIVES

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Discharge to POTW</u>	<u>Alternative III UV Oxidation</u>	<u>Alternative IV Carbon Adsorption</u>	<u>Alternative V Air Stripping</u>	<u>Alternative VI Biological Treatment w/Carbon Adsorption</u>
<u>LONG-TERM EFFECTIVENESS AND PERMANENCE (cont.)</u>						
Need for 5-year Review	Should be reviewed to ensure adequate protection of human health and environment.	See Alternative I. Also recommended to justify continued treatment.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
<u>REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME</u>						
Treatment Process Used	None.	POTW will provide treatment.	Ultra-violet oxidation.	Liquid-Phase Carbon Adsorption	Air stripping and vapor-phase treatment with carbon or catalytic oxidation.	Biological treatment and liquid-phase carbon adsorption
Amount Destroyed or Treated	None.	Contaminants in extracted groundwater will be treated.	All contaminants will be destroyed in process.	Contaminants transferred to carbon, destroyed during regeneration.	Contaminants will be removed from groundwater	Known to treat organic compounds. Chlorinated compounds will be adsorbed on carbon and destroyed during regeneration.
Reduction of Toxicity, Mobility, or Volume	None.	Toxicity, mobility, and volume reduced.	See Alternative II.	See Alternative II.	See Alternative II.	To be determined.
Irreversible Treatment	None.	Depends on POTW.	Irreversibly destroyed by UV oxidation.	Irreversibly destroyed during carbon regeneration.	See Alternative III.	Altered if biodegraded. Irreversibly destroyed during regeneration of carbon (if adsorbed on carbon).
Type & Quantity of Residuals Remaining after Treatment	No treatment, so most contamination remains.	Unknown, long-term treatment may not remove all contamination in aquifer, no residuals in treated groundwater.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.

TABLE 3.1 EVALUATION OF FINAL GROUNDWATER ALTERNATIVES

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Discharge to POTW</u>	<u>Alternative III UV Oxidation</u>	<u>Alternative IV Carbon Adsorption</u>	<u>Alternative V Air Stripping</u>	<u>Alternative VI Biological Treatment w/Carbon Adsorption</u>
<u>REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME (cont.)</u>						
Statutory Preference for Treatment	Does not satisfy.	May not satisfy.	Satisfies.	Satisfies.	Satisfies.	Satisfies.
<u>SHORT-TERM EFFECTIVENESS</u>						
Community Protection	Possible migration to drinking water aquifer may endanger community.	Installation and operation would not endanger community.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Worker Protection	No significant risk to workers.	Protection from contaminated cuttings from well drilling.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Impacts	Continued impact from existing conditions.	Aquifer drawdown may occur, no other impacts.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Time Until Action is Complete	Not applicable.	Estimated to be 10 years.	Estimated to be 10 years.	Estimated to be 10 years.	Estimated to be 10 years.	Estimated to be 10 years.
<u>IMPLEMENTABILITY</u>						
Ability to Construct and Operate	No construction or operation.	Easy to construct, currently in operation.	Easy to construct. May be most difficult alternative to operate.	Easy to construct and operate.	Most difficult to construct. Operation more difficult than carbon.	Easy to construct. Operation subject to environmental upsets, e.g. temperature, pH
Ease of Doing More Action if Needed	If more action determined to be necessary, may need to go through FS/ROD process.	Additional treatment process units can be added without difficulty.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Ability to Monitor Effectiveness	No monitoring.	Monitor well network in place.	Treated effluent can be readily monitored.	See Alternative III.	See Alternative III.	See Alternative III.

TABLE 3.1 EVALUATION OF FINAL GROUNDWATER ALTERNATIVES

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Discharge to POTW</u>	<u>Alternative III UV Oxidation</u>	<u>Alternative IV Carbon Adsorption</u>	<u>Alternative V Air Stripping</u>	<u>Alternative VI Biological Treatment w/Carbon Adsorption</u>
<u>IMPLEMENTABILITY (cont.)</u>						
Ability to Obtain Approvals and Coordinate with Other Agencies	Unlikely approval would be obtained	POTW will have to permit increased volume of discharge.	See Alternative II. Concentrations should comply with current permit.	See Alternative III.	See Alternative III.	See Alternative III.
Availability of Services and Capacities	No services or capacities required.	POTW able to handle increased volume.	Service will be provided by vendor. Monitoring services to be procured.	See Alternative III.	Service will need to be procured as well as monitoring.	See Alternative III.
Availability of Equipment, Specialist, and Materials	None required.	See Alternative I.	UV equipment/process chemicals available. Specialist needed to optimize operation.	Carbon and associated equipment readily available.	Air stripper, carbon and catalytic oxidizer needed, readily available.	Reactor vessel and carbon beds needed, readily available.
Availability of Technologies	None required.	See Alternative I.	UV technology available.	Carbon technology available.	Air stripping and emission control technology available.	Biodegradation and carbon technology available.
<u>COST</u>						
Capital Cost	0	\$30,000	\$186,000	\$38,500	\$46,000	\$89,400
Annual Operating Cost	0	\$7,000	\$31,000	\$32,800	\$12,000	\$12,000 to \$26,400
Present Worth Cost (assume 10% discount rate)	0	\$72,000	\$370,000	\$240,000	\$120,000 (does not include emission control)	\$160,000 to \$248,000

TABLE 3.2: EVALUATION OF FINAL SOIL ALTERNATIVES

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Off-site Treatment</u>	<u>Alternative III Enhanced Bio-Treatment</u>	<u>Alternative IV X-19 Treatment</u>	<u>Alternative V Excalibur Process</u>
<u>OVERALL PROTECTIVENESS</u>					
Human Health Protection - Direct Contact/ Soil Ingestion	No reduction in risk.	Will reduce risk since soil will be excavated and taken off-site.	Will reduce risk by excavating and treating soil.	Treatability study to determine effectiveness of X-19.	Treatability study to determine effectiveness of Excalibur Process.
Environmental Protection	Contaminants would continue to migrate to groundwater.	Soil would be removed and prevent further migration of contamination to groundwater.	See Alternative III.	See Alternative III.	See Alternative III.
<u>COMPLIANCE WITH ARARs</u>					
- Chemical Specific ARARs	Would not comply with ARARs.	Would comply with ARARs.	Expected to comply with ARARs.	To be determined.	To be determined.
<u>LONG-TERM EFFECTIVENESS AND PERMANENCE</u>					
Magnitude of Residual Risk - Direct Contact/ Soil Ingestion	Source and associated risk still remain.	Risk eliminated, source is removed.	See Alternative III.	See Alternative III.	See Alternative III.
Adequacy and Reliability of Controls	No controls over remaining contamination.  No reliability.	Treatment and disposal off-site will control contaminants adequately.  Reliable treatment method.	Contaminants would be controlled adequately. Soil would be contained. Air effluent would be treated before emission.  Reliable treatment. Only maintenance would be to maintain the biomass.	See Alternative IV. There may be no air emissions from this alternative.  Reliable treatment. Only maintenance would be to maintain the biomass.	See Alternative IV. There would be no air emissions from this process.  Reliability is unknown since the process has only recently been developed.



TABLE 3.2: EVALUATION OF FINAL SOIL ALTERNATIVES

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Off-site Treatment</u>	<u>Alternative III Enhanced Bio-Treatment</u>	<u>Alternative IV X-19 Treatment</u>	<u>Alternative V Excalibur Process</u>
<u>LONG-TERM EFFECTIVENESS AND PERMANENCE (cont.)</u>					
Need for 5-year Review	Should be performed to ensure adequate protection of human health and environment	Not necessary, treatment may not take 5 years.	See Alternative III.	See Alternative III.	See Alternative III.
<u>REDUCTION OF TOXICITY, MOBILITY, AND/OR VOLUME</u>					
Treatment Process Used	None.	Off-site incineration.	Biological degradation and vapor extraction.	Biological degradation.	Soil washing and UV oxidation of wash solution.
Amount Destroyed or Treated	None.	All contaminants present destroyed.	Organic compounds biodegraded, chlorinated compounds transferred to carbon.	Vendor claims X-19 will degrade all compounds present. Treatability study recommended.	Vendor claims process will destroy all compounds present. Treatability study recommended.
Reduction of Toxicity, Mobility, or Volume	None.	Reduced toxicity, mobility and volume.	See Alternative III.	To be determined.	To be determined.
Irreversible Treatment	None.	Incineration would be irreversible.	Biodegradation would be irreversible. Contaminants transferred to carbon would be irreversibly destroyed during regeneration.	Biodegradation would be irreversible.	Vendor claims process would be irreversible.
Type & Quantity of Residuals Remaining after Treatment	No treatment, so most contamination remains.	None.	Very low levels of organic contaminants may remain.	To be determined.	To be determined.
Statutory Preference for Treatment	Does not satisfy.	Does not satisfy.	Satisfies.	Satisfies.	Satisfies.

**TABLE 3.2: EVALUATION OF FINAL SOIL ALTERNATIVES**

<u>Criteria</u>	<u>Alternative I No Action</u>	<u>Alternative II Off-site Treatment</u>	<u>Alternative III Enhanced Bio-Treatment</u>	<u>Alternative IV X-19 Treatment</u>	<u>Alternative V Excalibur Process</u>
<u>SHORT-TERM EFFECTIVENESS</u>					
Community Protection	Migration of contaminants to groundwater may increase risk to public.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Worker Protection	No significant risk to workers.	See Alternative II.	See Alternative II.	See Alternative II.	See Alternative II.
Environmental Impacts	Continued impact from existing conditions.	No impact.	No impact.	No impact.	No impact.
Time Until Action is Complete	Not applicable.	6 months.	1 to 2 years.	1 to 2 years.	1 to 2 years.
<u>IMPLEMENTABILITY</u>					
Ability to Construct and Operate	No construction or operation.	Simple to implement.	Construction and operation fairly straight forward.	Simple to construct and operate.	To be determined.
Ease of Doing More Action if Needed	May need to go through FS/ROD process to perform additional work.	Once incinerated, additional work would be difficult to perform.	Additional work would not be difficult to implement.	See Alternative IV.	See Alternative IV.
Ability to Monitor Effectiveness	No monitoring performed.	Treatment facility will determine effectiveness.	Monitoring can readily be performed.	See Alternative IV.	See Alternative IV.
Ability to Obtain Approvals and Coordinate with Other Agencies	Unlikely other agencies would accept this option.	See Alternative II.	An air emissions permit from BAAQMD required.	See Alternative II.	See Alternative II.
Availability of Services and Capacities	No services or capacities required.	Need transportation and a treatment facility.	See Alternative I.	See Alternative I.	See Alternative I.

TABLE 3.2: EVALUATION OF FINAL SOIL ALTERNATIVES

<u>Criteria</u>	<u>Alternative I</u> <u>No Action</u>	<u>Alternative II</u> <u>Off-site Treatment</u>	<u>Alternative III</u> <u>Enhanced Bio-Treatment</u>	<u>Alternative IV</u> <u>X-19 Treatment</u>	<u>Alternative V</u> <u>Excalibur Process</u>
<u>IMPLEMENTABILITY (cont.)</u>					
Availability of Equipment, Specialist, and Materials	None required.	Excavation equipment available.	Excavation equipment available.	Excavation equipment and X-19 additive available.	Process equipment will need to be fabricated.
Availability of Technologies	None required.	Limited number of incinerators.	Technology available.	Only one vendor of technology.	Only one vendor of technology.
<u>COST</u>					
Capital Cost	\$0	\$1,400,000	\$165,000 to \$250,000	\$100,000	\$88,000 to \$220,000
Annual Operating Cost	\$0	\$293,000	\$200,000	\$200,000	\$200,000
Present Worth Cost (assume 10% discount rate)	\$0	\$1,693,000	\$365,000 to \$450,000	\$300,000	\$288,000 to \$420,000

DRAFT

TABLE 3.3  
DOCUMENTATION OF ARARs FOR GROUNDWATER REMEDIAL ALTERNATIVES  
JASCO CHEMICAL CORPORATION SITE  
MOUNTAIN VIEW, CALIFORNIA

<u>STATUTE OR REGULATION</u>	<u>ALTERNATIVE I</u>	<u>ALTERNATIVE II</u>	<u>ALTERNATIVE III</u>	<u>ALTERNATIVES IV AND VI</u>	<u>ALTERNATIVE V</u>
Federal and State Safe Drinking Water Act including National Primary Drinking Water Standards and Maximum Contaminant Level Goals (MCLGs)	Alternative does not provide for prevention of migration of groundwater to drinking water sources or aquifer restoration. A-aquifer does not meet State criteria for potential drinking water source.	Alternative will remove A-aquifer groundwater containing contaminants in excess of MCLs and prevent lateral and vertical migration of contaminants. A-aquifer does not meet criteria as a drinking water source.	Alternative will remove A-aquifer groundwater containing contaminants in excess of MCLs and prevent lateral and vertical migration of contaminants. A-aquifer does not meet criteria as a drinking water source.	Alternatives will remove A-aquifer groundwater containing contaminants in excess of MCLs and prevent lateral and vertical migration of contaminants. A-aquifer does not meet criteria as a drinking water source.	Alternative will remove A-aquifer groundwater containing contaminants in excess of MCLs and prevent lateral and vertical migration of contaminants. A-aquifer does not meet criteria as a drinking water source.
Federal Clean Water Act, including Water Quality Criteria, National Pollutant Discharge Elimination System and National Pretreatment Standards	Not applicable. Alternative does not involve treatment or discharge of wastes.	Extracted groundwater will continue to be discharged to POTW under existing permit with City of Mountain View NPDES permit will not be required.	Extracted groundwater will continue to be discharged to POTW under existing permit with City of Mountain View NPDES permit will not be required.	Extracted groundwater will continue to be discharged to POTW under existing permit with City of Mountain View NPDES permit will not be required.	Extracted groundwater will continue to be discharged to POTW under existing permit with City of Mountain View NPDES permit will not be required.
Federal Clean Air Act and State Air Resources Act including National Primary and Secondary Ambient Air Quality Standards and Bay Area Management Pollution Control District Rules and Regulations	Not applicable. Alternative does not involve on-site activities that would result in emission of regulated compounds.	Not applicable. Alternative does not involve on-site activities that would result in emission of regulated compounds.	Not applicable. Alternative does not involve on-site activities that would result in emission of regulated compounds.	Not applicable. Alternatives do not involve on-site activities that would result in emission of regulated compounds.	Emissions from treatment facilities are not expected to exceed limits for control. Exemption from permit due to low emissions would be required.
Hazardous Waste Management Systems General	Not applicable. Alternative does not involve the generation or delisting of a hazardous waste.	Not applicable. No delisting of wastes will be required under this alternative.	Not applicable. No delisting of wastes will be required under this alternative.	Not applicable. No delisting of wastes will be required under this alternative.	Not applicable. No delisting of wastes will be required under this alternative.
Standards Applicable to Generators of Hazardous Waste	Not applicable. Alternative does not involve the generation and transportation of hazardous waste.	Not applicable. Alternative does not involve the generation and transportation of hazardous waste.	Not applicable. Alternative does not involve the generation and transportation of hazardous waste.	Generator standards will be met for management of treatment residues (e.g. spent carbon)	Not applicable. Alternative does not involve the generation and transportation of hazardous waste.
RCRA - Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, including General Facility Standards, Preparedness and Prevention, Contingency Plan and Emergency Procedures, Manifest System, Record-keeping and Reporting, Releases from Solid Waste Management Units, Closure, Financial Requirements, Use and Management of Containers, Waste Piles, Miscellaneous Units	Not applicable. Alternative does not involve the treatment, storage or disposal of hazardous wastes.	Not applicable. Treated water will be discharged to POTW in accordance with Clean Water Act.	Not applicable. Treated water will be discharged to POTW in accordance with Clean Water Act.	Spent carbon from groundwater treatment system will be transported and recycled (regenerated) in accordance with regulations.	Not applicable. Treated water will be discharged to POTW in accordance with Clean Water Act.

TABLE 3.3  
DOCUMENTATION OF ARARs FOR GROUNDWATER REMEDIAL ALTERNATIVES  
JASCO CHEMICAL CORPORATION SITE  
MOUNTAIN VIEW, CALIFORNIA

DRAFT

<u>STATUTE OR REGULATION</u>	<u>ALTERNATIVE I</u>	<u>ALTERNATIVE II</u>	<u>ALTERNATIVE III</u>	<u>ALTERNATIVES IV AND VI</u>	<u>ALTERNATIVE V</u>
Land Disposal Restrictions	Not applicable. Alternative does not involve the treatment, storage or disposal of hazardous wastes.	Not applicable. Alternative does not involve land disposal of solid wastes.	Not applicable. Alternative does not involve land disposal of solid wastes.	Not applicable. Alternatives do not involve land disposal of solid wastes.	Not applicable. Alternative does not involve land disposal of solid wastes.
Federal and State Occupational Health and Safety Act	Not applicable. No on-site activities will be conducted.	Site Activities will be conducted in accordance with these acts.	Site Activities will be conducted in accordance with these acts.	Site Activities will be conducted in accordance with these acts.	Site Activities will be conducted in accordance with these acts.
Transportation of Wastes (Federal/ State) including Federal Hazardous Material Transportation Regulations/ Standards Applicable to Generators of Hazardous Waste and State Highway Patrol Hazardous Material Regs	Not applicable. Alternative does not involve the transportation of hazardous wastes.	Not applicable. Alternative does not involve the transportation of hazardous wastes.	Not applicable. Alternative does not involve the transportation of hazardous wastes.	Spent carbon from groundwater treatment system will be transported and recycled (regenerated) in accordance with regulations.	Not applicable. Alternative does not involve the transportation of hazardous wastes.
Air Toxics "Hot Spots" Information and Assessment Act	Not applicable. Alternative does not involve new facilities that would result in unacceptable air emissions.	Not applicable. Alternative does not involve new facilities that would result in unacceptable air emissions.	Not applicable. Alternative does not involve new facilities that would result in unacceptable air emissions.	Not applicable. Alternatives do not involve new facilities that would result in unacceptable air emissions.	Air emissions not expected to exceed unacceptable limits. Variance may be required.
Porter-Cologne Water Quality Control Act and California Water Quality Objectives	Alternative does not provide for A-aquifer restoration. A-aquifer does not meet State criteria as drinking water source.	Alternative will improve groundwater quality by removing contaminated groundwater and preventing contaminant migration. A-aquifer does not meet State criteria as a potential drinking water source.	Alternative will improve groundwater quality by removing contaminated groundwater and preventing contaminant migration. A-aquifer does not meet State criteria as a potential drinking water source.	Alternative will improve groundwater quality by removing contaminated groundwater and preventing contaminant migration. A-aquifer does not meet State criteria as a potential drinking water source.	Alternative will improve groundwater quality by removing contaminated groundwater and preventing contaminant migration. A-aquifer does not meet State criteria as a potential drinking water source.
Water Well Standards	Not applicable. No additional wells will be constructed.	Additional wells will be constructed according to Water Well Standards.	Additional wells will be constructed according to Water Well Standards.	Additional wells will be constructed according to Water Well Standards.	Additional wells will be constructed according to Water Well Standards.
California Hazardous Waste Management and Control Regulations including Waste Discharge Reports and Requirements, Discharge of Waste to Land, Hazardous Waste Control Laws, Hazardous Substance Account and Cleanup Bond Acts, Hazardous Substance Act and Criteria for Identification of Hazardous and Extremely Hazardous Wastes/Threshold Limit Conc.	Not applicable. No on-site activities will be conducted.	Extracted groundwater will be managed in accordance with State Hazardous Waste Control Regulations.	Extracted groundwater will be managed in accordance with State Hazardous Waste Control Regulations.	Extracted groundwater will be managed in accordance with State Hazardous Waste Control Regulations.	Extracted groundwater will be managed in accordance with State Hazardous Waste Control Regulations.
Underground Storage Tank Regulation and Underground Storage of Hazardous Substance Requirements	Not applicable. Alternative does not involve storage in or removal of underground storage facilities.	Not applicable. Alternative does not involve storage in, or removal of underground storage facilities.	Not applicable. Alternative does not involve storage in or removal of underground storage facilities.	Not applicable. Alternatives do not involve storage in or removal of underground storage facilities.	Not applicable. Alternative does not involve storage in or removal of underground storage facilities.

TABLE 3.4  
DOCUMENTATION OF ARARs FOR SOIL REMEDIAL ALTERNATIVES  
JASCO CHEMICAL CORPORATION SITE  
MOUNTAIN VIEW, CALIFORNIA

<u>STATUTE OR REGULATION</u>	<u>ALTERNATIVE I</u>	<u>ALTERNATIVE II</u>	<u>ALTERNATIVES III TO V</u>
Federal and State Safe Drinking Water Act including National Primary Drinking Water Standards and Maximum Contaminant Level Goals (MCLGs)	Not applicable. Alternative does not address groundwater quality.	Alternative does not involve groundwater remediation. The removal of contaminated soil will likely result in a decrease in the presence and concentrations of contaminants in groundwater.	Alternatives do not involve groundwater remediation. The removal of contaminated soil will likely result in a decrease in the presence and concentrations of contaminants in groundwater.
Federal Clean Water Act, including Water Quality Criteria, National Pollutant Discharge Elimination System and National Pretreatment Standards	Not applicable. Alternative does not involve treatment or discharge of wastes	Not applicable. Alternative does not involve on-site treatment or discharge of wastes to waterways.	Not applicable. Alternatives do not involve on-site treatment or discharge of wastes to waterways.
Federal Clean Air Act and State Air Resources Act including National Primary and Secondary Ambient Air Quality Standards and Bay Area Management Pollution Control District Rules and Regulations	Not applicable. Alternative does not involve removal of soil.	Soil removal will be conducted in accordance with air quality regulations as administered by BAAQMD.	Soil removal will be conducted in accordance with air quality regulations as administered by BAAQMD.
Hazardous Waste Management Systems General	Not applicable. Alternative does not involve the generation or delisting of a hazardous waste.	No delisting will be required. Excavated soil will be treated and disposed off-site.	Soil replaced on-site after treatment may require waste delisting.
Standards Applicable to Generators of Hazardous Waste	Not applicable. Alternative does not involve the generation or transportation of hazardous waste.	Generator standards will be met for the generation and off-site disposal of hazardous waste.	Generator standards will be met for the generation, treatment and disposal of hazardous waste.

TABLE 3.4  
DOCUMENTATION OF ARARs FOR SOIL REMEDIAL ALTERNATIVES  
JASCO CHEMICAL CORPORATION SITE  
MOUNTAIN VIEW, CALIFORNIA

DRAFT

STATUTE OR REGULATION

ALTERNATIVE I

ALTERNATIVE II

ALTERNATIVES III TO V

RCRA – Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities, including General Facility Standards, Preparedness and Prevention, Contingency Plan and Emergency Procedures, Manifest System, Record-keeping and Reporting, Releases from Solid Waste Management Units, Closure, Financial Requirements, Use and Management of Containers, Waste Piles, Misc. Units

Not applicable. Alternative does not involve the treatment, storage or disposal of hazardous wastes.

Excavated soil will be transported and treated off-site in accordance with RCRA. Transportation of wastes will comply with manifesting procedures.

Excavated soil will be treated on-site in accordance with RCRA. Remedial Design Report is likely to satisfy requirements for facility permit for soil treatment. Closure/ Post-Closure procedures may be applicable for land treatment unit after soil treatment is complete.

Land Disposal Restrictions

Not applicable. Alternative does not involve the treatment, storage or disposal of hazardous wastes.

TSDf will ensure wastes transported off-site will conform with land disposal restrictions.

Treated soil is expected to conform with land disposal restrictions for on-site replacement.

Federal and State Occupational Health and Safety Act

Not applicable. No on-site activities would be conducted.

Site activities will be conducted in accordance with these acts.

Site activities will be conducted in accordance these acts.

Transportation of Wastes (Federal and State) including Federal Hazardous Material Transportation Regulations and Standards Applicable to Generators of Hazardous Waste and California Highway Patrol Hazardous Material Regulations

Not applicable. Alternative does not involve the transportation of hazardous wastes.

Hazardous materials will be transported by a licensed hazardous waste transporter in accordance with State and Federal regulations.

Not applicable. Soil will be treated to acceptable levels and replaced on-site.

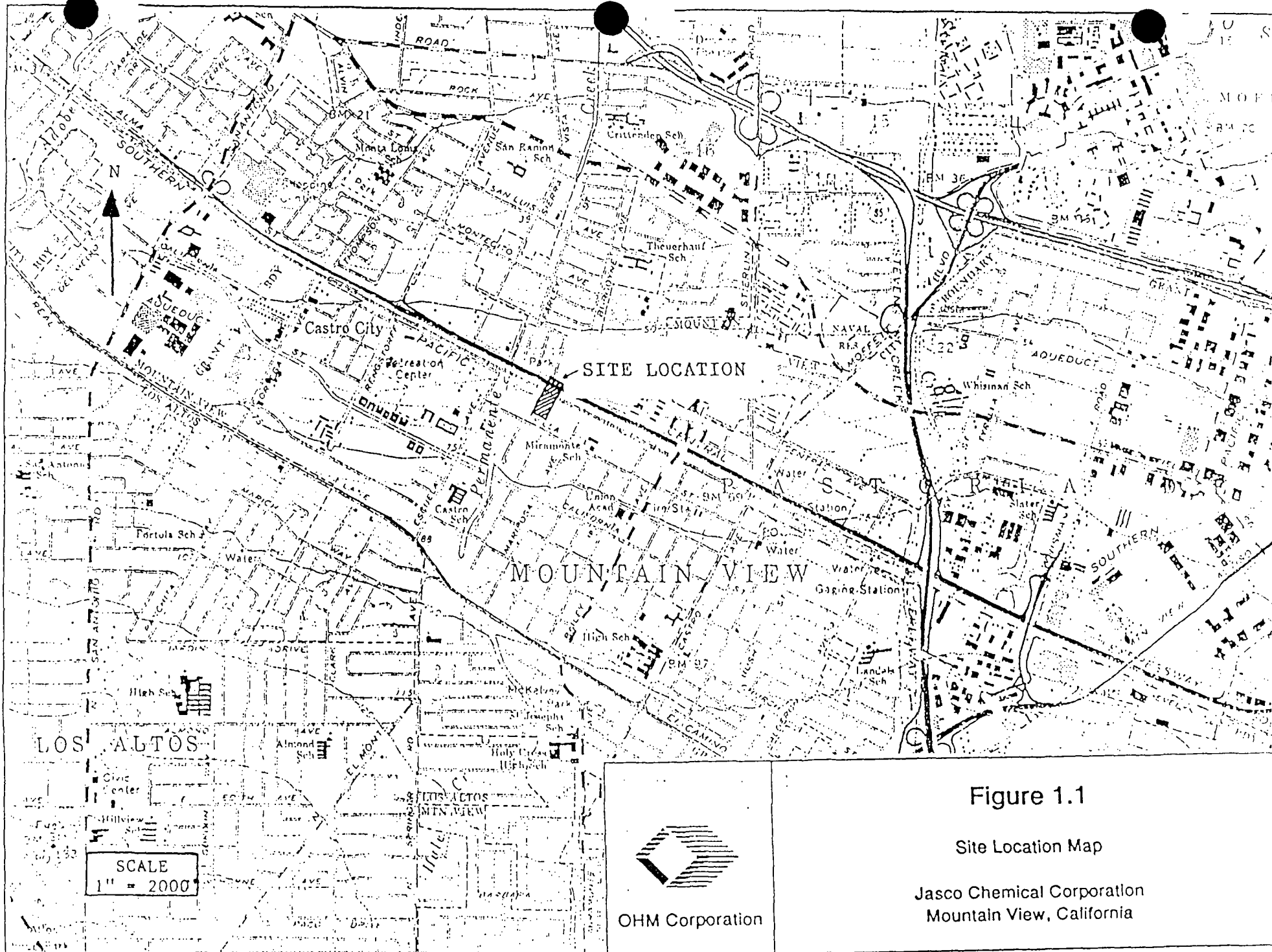
TABLE 3.4  
DOCUMENTATION OF ARARs FOR SOIL REMEDIAL ALTERNATIVES  
JASCO CHEMICAL CORPORATION SITE  
MOUNTAIN VIEW, CALIFORNIA

*DRAFT*

<u>STATUTE OR REGULATION</u>	<u>ALTERNATIVE I</u>	<u>ALTERNATIVE II</u>	<u>ALTERNATIVES III TO V</u>
Air Toxics "Hot Spots" Information and Assessment Act	Not applicable. Alternative does <i>not</i> involve construction of new facilities.	No on-site treatment. Emissions of regulated compounds are not expected.	Alternatives will employ measures to contain and control unacceptable air emissions.
Porter-Cologne Water Quality Control Act and California Water Quality Objectives	Not applicable. Alternative does not address groundwater quality.	Not applicable. Alternative does not involve groundwater remediation.	Not applicable. Alternatives do not involve groundwater remediation.
Water Well Standards	Not applicable. No additional wells would be constructed.	Not applicable. Alternative does not involve well construction.	Not applicable. Alternatives do not involve well construction.
California Hazardous Waste Management and Control Regulations including Waste Discharge Reports and Requirements, Discharge of Waste to Land, Hazardous Waste Control Laws, Hazardous Substance Account Act, Hazardous Substance Cleanup Bond Act, Hazardous Substance Act and Criteria for Identification of Hazardous and Extremely Hazardous/Wastes/Threshold Limit Conc.	Not applicable. Alternative does not involve the removal of soil.	Excavated soil will be transported and treated off-site in accordance with State hazardous waste control regulations.	Excavated soil will be treated on-site in accordance with State Hazardous Waste Control Requirements. Treated soil replaced on-site may require a variance from State hazardous waste disposal regulations.
Underground Storage Tank Regulation and Underground Storage of Hazardous Substance Requirements	Not applicable. Alternative does not involve storage in or removal of underground storage facilities.	Not applicable. Alternative does not involve storage in, or removal of underground storage facilities.	Not applicable. Alternatives do not involve storage in or removal of underground storage facilities.



**FIGURES**



DRAWING NUMBER 0007403-A1.2

APPROVED BY

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DRAWN BY E. Kwong 12-11-90

OHM CORPORATION  
WALNUT CREEK, CA

PLOT SCALE: 1" = 110'

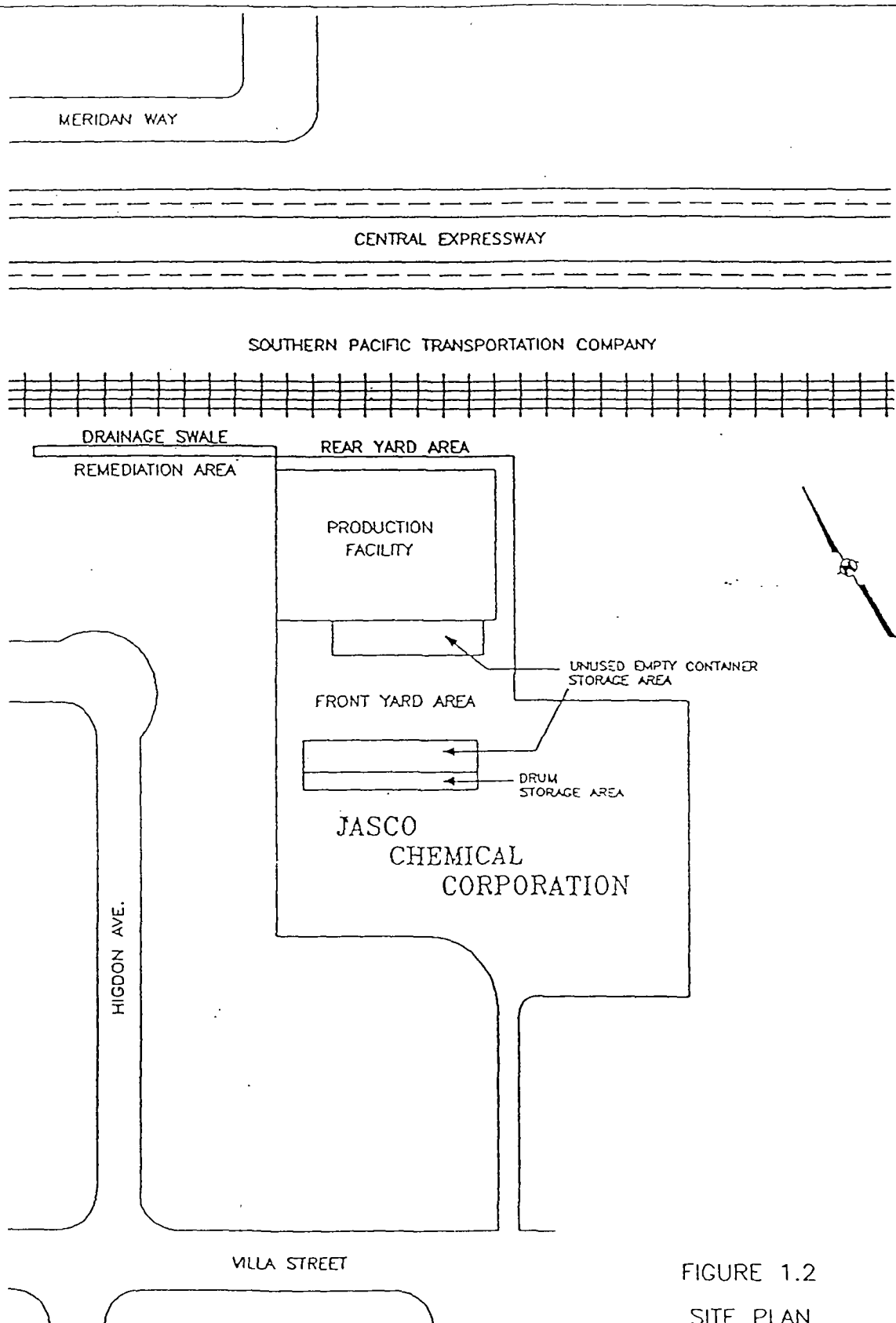
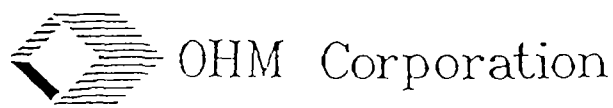


FIGURE 1.2

SITE PLAN  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA



DRAWING NUMBER 0007403-A1.3

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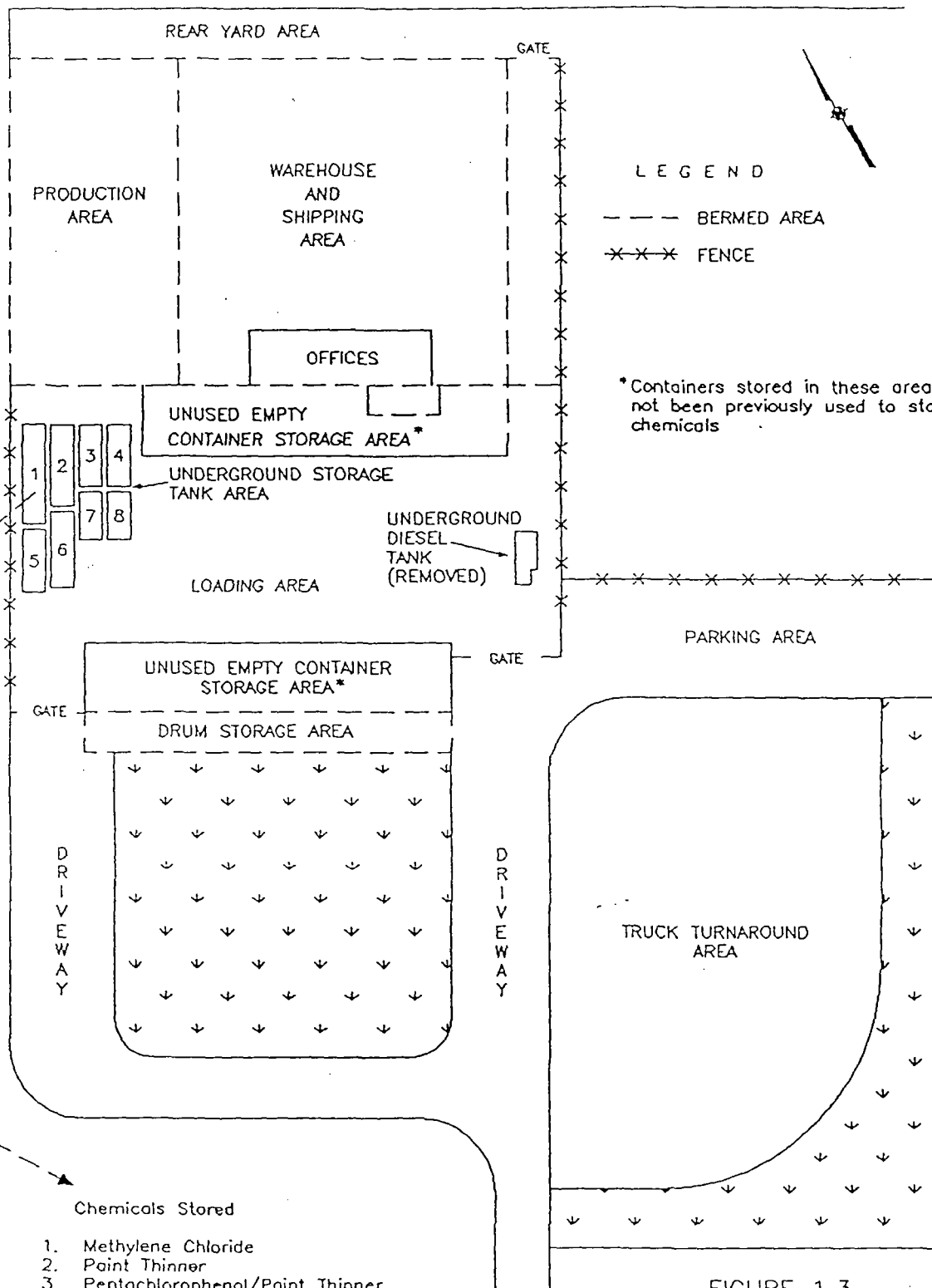
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OHM CORPORATION  
WALNUT CREEK, CA

PLOT SCALE: 1"=50'



# LEGEND

--- BERMED AREA

\*\*\* FENCE

\*Containers stored in these areas have not been previously used to store chemicals

## Chemicals Stored

1. Methylene Chloride
2. Paint Thinner
3. Pentachlorophenol/Paint Thinner
4. Denatured Alcohol
5. Methanol
6. Deodorized Kerosene
7. Lacquer Thinner
8. Acetone

FIGURE 1.3

EXISTING AND FORMER STRUCTURES  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA



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NOT SCALE 1" = 110'

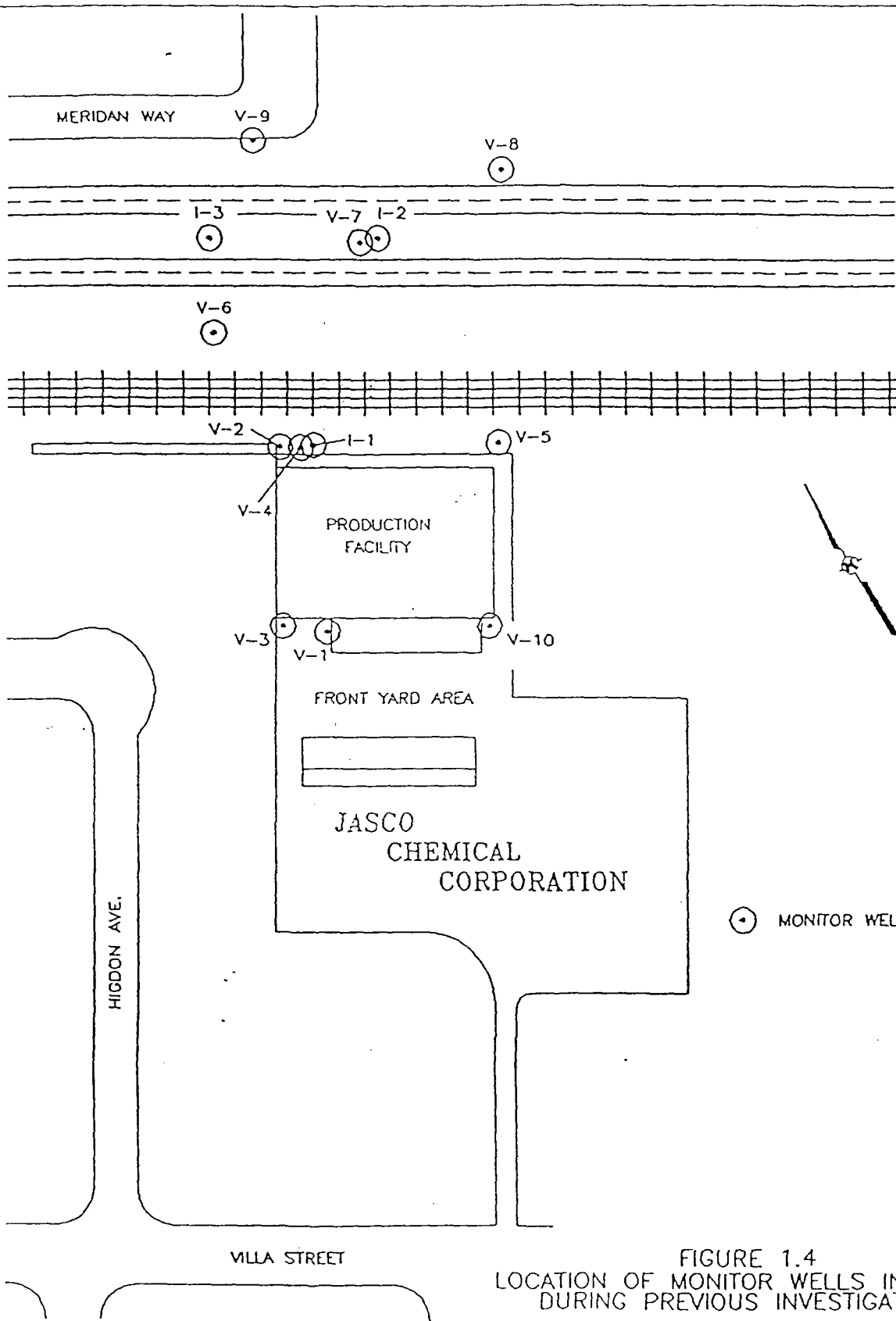


FIGURE 1.4  
LOCATION OF MONITOR WELLS INSTALLED  
DURING PREVIOUS INVESTIGATIONS

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PLOT SCALE = 1" = 30'

OHM CORPORATION  
WALNUT CREEK, CA

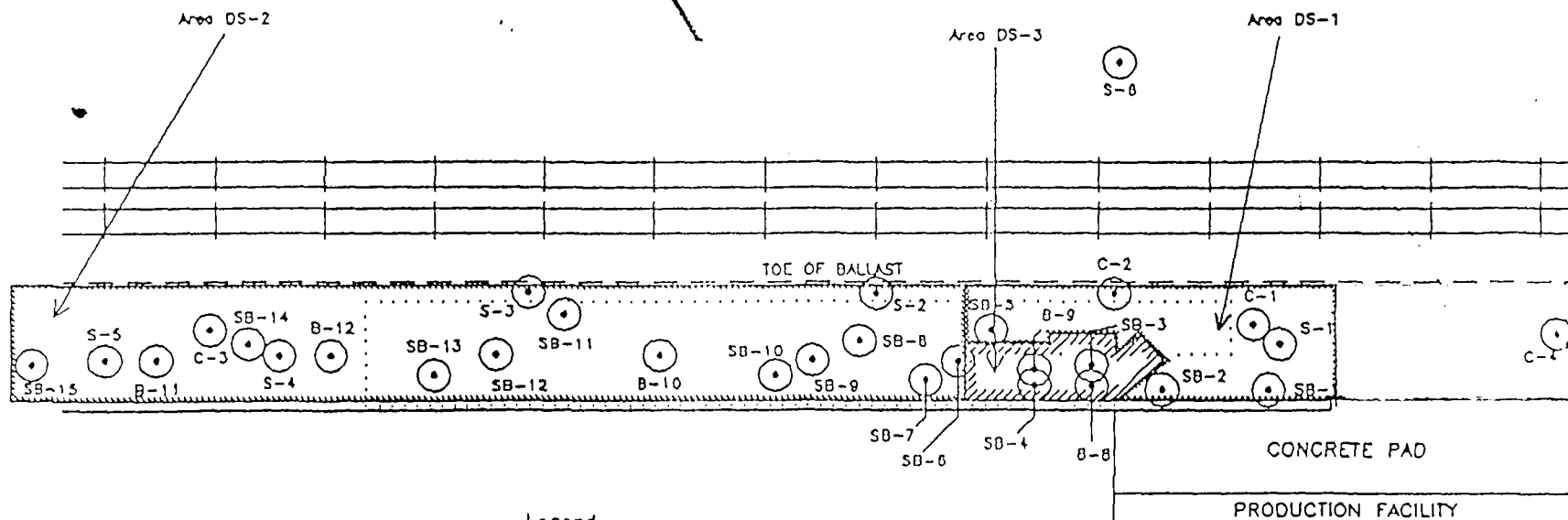
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DRAWING NUMBER 0007402-A4.1

CENTRAL EXPRESSWAY



Legend



Borehole Location

..... Impermeable Membrane Runoff Collection System

FIGURE 1.5  
LOCATION OF SAMPLE POINTS AND  
DELINITION OF DRAINAGE SWALE AREAS

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA



OHM Corporation

PLOT SCALE = 1"=30'

OHM CORPORATION  
WALNUT CREEK, CA

DRAWN BY  
E. Kwong 12-18-90

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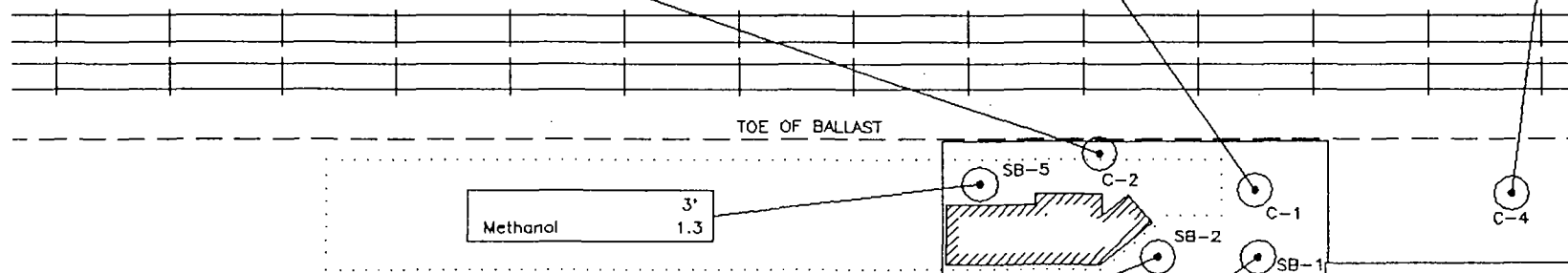
DRAWING NUMBER 0007403-A4.4

CENTRAL EXPRESSWAY

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.02	0.016	0.036	0.11	0.063	0.41	ND
1,1-DCE	ND	ND	ND	0.03	ND	0.036	ND
1,2-DCE	ND	ND	ND	ND	ND	0.015	ND
1,1,1-TCA	0.099	0.052	0.016	0.095	0.052	0.016	ND
Bromoform	ND	ND	ND	ND	ND	0.019	ND
Methylene Chloride	ND	ND	0.14	0.27	0.71	ND	ND
Trichloroethene	0.015	ND	ND	0.0073	ND	ND	ND
Low-Med BP HC	ND	ND	ND	2800	1300	2600	ND
Toluene	0.023	ND	ND	0.005	ND	0.085	0.018
Xylene	ND	ND	ND	0.01	ND	0.038	0.026

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.12	0.38	0.038	ND	0.72	2.2	3
1,1-DCE	0.39	1.7	0.025	0.17	0.24	0.15	ND
1,1,1-TCA	15	61	0.59	5.3	6.8	ND	ND
Bromoform	ND	ND	ND	ND	ND	0.17	0.11
Methylene Chloride	0.9	ND	0.75	ND	4.2	3.2	ND
Tetrachloroethene	ND	0.065	ND	0.052	ND	4	ND
Trichloroethene	ND	0.05	ND	ND	ND	ND	ND
Isopropanol	76	ND	ND	ND	ND	ND	ND
Methanol	60	ND	ND	ND	ND	ND	ND
Low-Med BPHC	2600	6700	170	1300	120	380	38
Toluene	37	110	1.1	3.4	4.1	6.3	1.4
Xylene	11	37	0.87	5.5	2.6	5.9	1.5
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.37

No concentrations  
exceeding detection  
limit.



Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- Area of Interim Soil Excavation
- All concentrations of contaminants given in mg/kg

	3'
1,1-DCA	1.4
1,1,1-TCA	2.6
Acetone	6.3
Methylene Chloride	1.7
Toluene	0.3
Acetone	8.8
Methanol	5.0
TPH (Kerosene)	10
TPH (Paint Thinner)	5.2

	3'
1,1-DCA	0.54
1,1,1-TCA	1.1
Methylene Chloride	1.3
Acetone	1.1
Ethanol	0.7
Methanol	3.3

FIGURE 1.6  
DISTRIBUTION OF TARGET CONSTITUENTS  
3-30', FORMER DRAINAGE SWALE, DS-1

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

OHM Corporation

PLOT SCALE = 1"=30'

OHM CORPORATION  
WALNUT CREEK, CA

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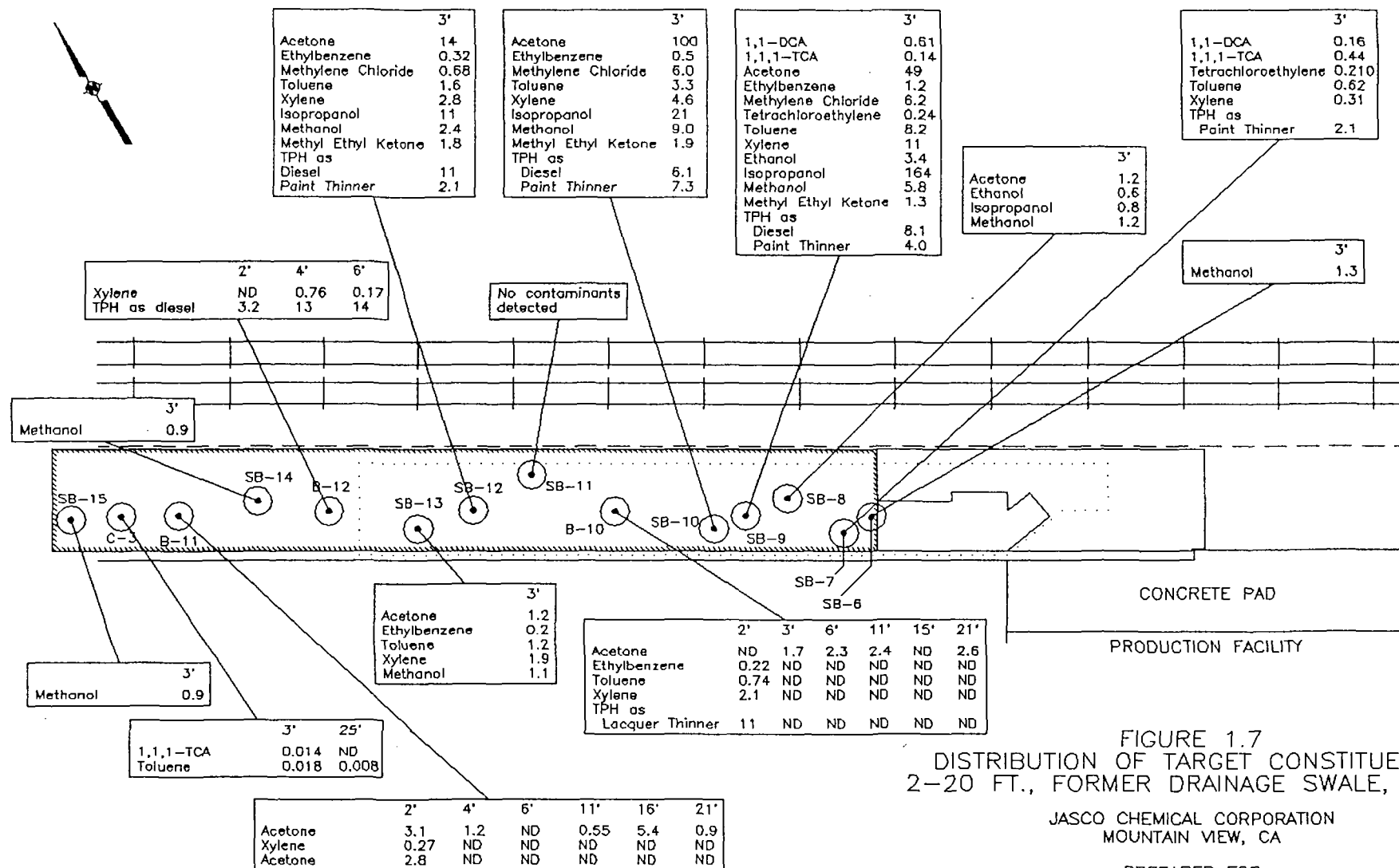


FIGURE 1.7  
DISTRIBUTION OF TARGET CONSTITUENTS  
2-20 FT., FORMER DRAINAGE SWALE, DS-2

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

OHM Corporation

# Legend



Borehole Location

Impermeable Membrane Runoff Collection System

All concentrations of contaminants  
given in mg/kg



PLOT SCALE = 1"=30'

OHM CORPORATION  
WALNUT CREEK, CA

DRAWN BY  
E. Kwong 12-18-90

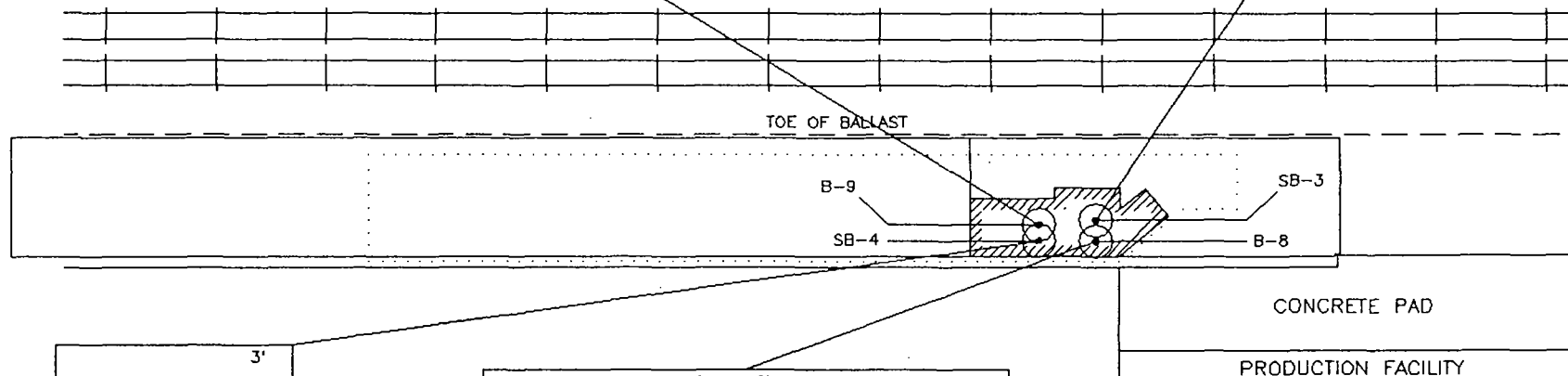
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DRAWING NUMBER 0007403-A4.6

	2'	4'	6'	11'	16'	21'
1,1-DCA	ND	2.2	0.68	0.23	ND	ND
1,1-DCE	0.16	ND	ND	ND	ND	ND
1,1,1-TCA	0.34	30	28	0.29	ND	ND
2-Propanone	24	25	6.2	5.1	ND	ND
Bromodichloromethane	0.16	ND	ND	ND	ND	ND
Ethylbenzene	ND	3	4.2	ND	ND	ND
Methylene Chloride	9.3	42	21	7.4	16	15
Tetrachloroethane	ND	0.87	1.3	ND	ND	ND
TCE	ND	1.4	1.5	ND	ND	ND
Toluene	2.3	38	41	0.27	ND	ND
Xylene	0.45	18	27	ND	ND	ND
Acetone	16	25	1.8	27	12	4
Isopropanol	ND	1.5	ND	ND	ND	ND
TPH as						
Lacquer Thinner	16	ND	ND	ND	ND	ND
Paint Thinner	96	5000	2000	29	ND	ND

	3'
1,1,1-TCA	47
Acetone	91
Methylene Chloride	210
Toluene	38
Xylene	27
Ethanol	20
Isopropanol	18
Methanol	32
TPH as	
Kerosene	150
Paint Thinner	320



	3'
1,1-DCA	1.2
1,1,1-TCA	7.3
Acetone	28
Ethylbenzene	2.2
Methylene Chloride	64
Tetrachloroethylene	1.0
TCE	0.56
Toluene	17
Xylene	210
Isopropanol	60
Methanol	14
TPH as	
Kerosene	140
Paint Thinner	320

	3'	5'	10'	15'	20'
1,1-DCA	27	34	0.98	0.2	0.76
1,1-DCE	13	ND	ND	ND	ND
1,1,1-TCA	ND	1.5	22	2.3	0.21
1,2-DCA	3.9	ND	ND	ND	ND
Carbon Tetrachloride	650	ND	ND	ND	ND
Chloroform	2.3	ND	ND	ND	ND
Ethylbenzene	170	NA	NA	NA	NA
Methylene Chloride	3400	2.4	71	8.9	18
Tetrachloroethane	16	0.0067	0.31	ND	ND
TCE	490	ND	0.85	0.088	ND
Toluene	1700	NA	NA	NA	NA
Acetone	270	NA	15	NA	13
Isopropanol	3.5	NA	1	NA	2.5
TPH as					
Paint Thinner	11000	NA	2600	NA	20

#### Legend



Borehole Location

Impermeable Membrane Runoff Collection System

All concentrations of contaminants given  
in mg/kg

FIGURE 1.8  
DISTRIBUTION OF TARGET CONSTITUENTS  
2-30', FORMER DRAINAGE SWALE, DS-3

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA



OHM Corporation

DRAWING NUMBER 0007403-A4.7

APPROVED BY

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DRAWN BY

E. Kwong 12-11-90

OHM CORPORATION  
WALNUT CREEK, CA

PLOT SCALE: 1" = 30'

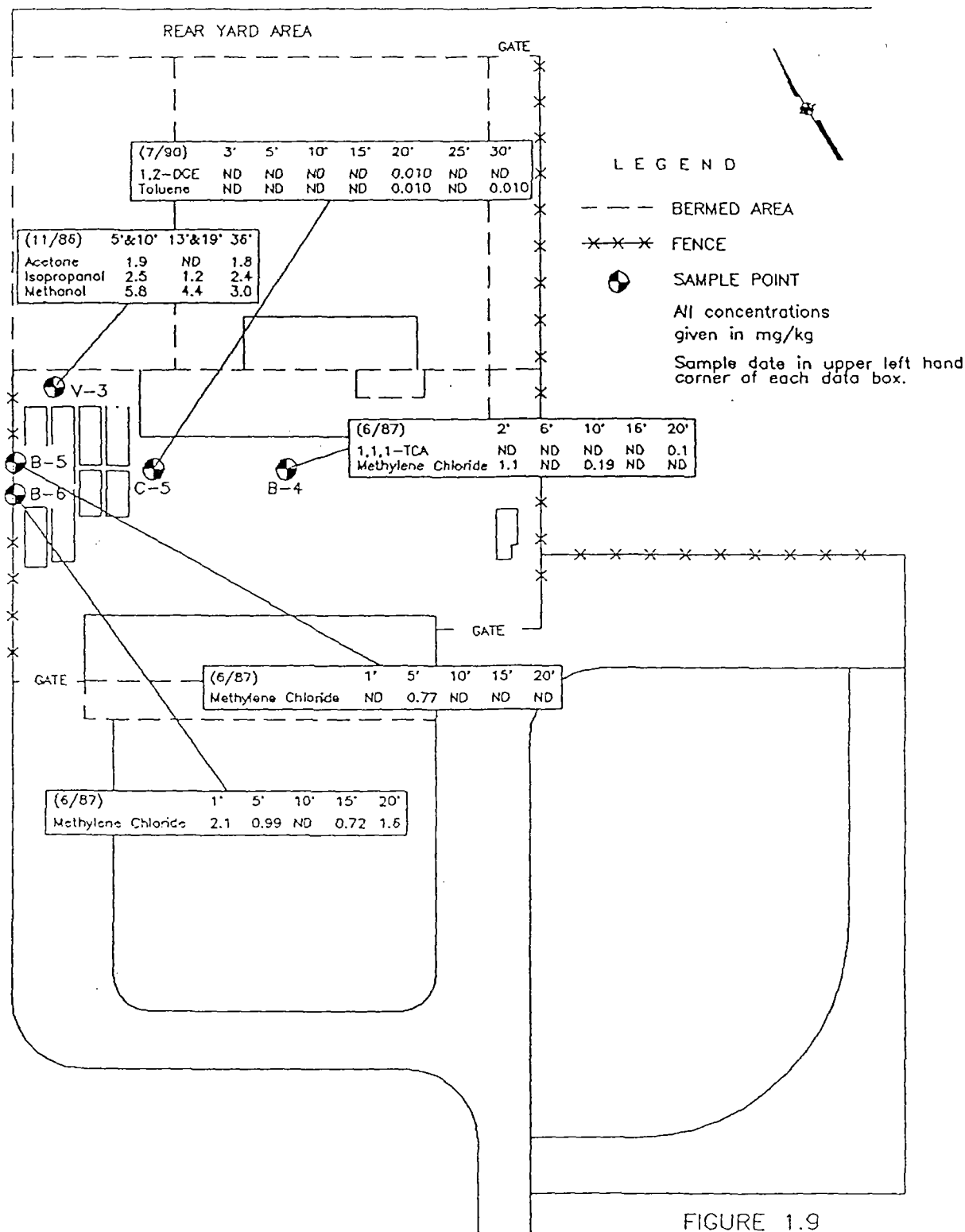


FIGURE 1.9  
DISTRIBUTION OF TARGET CONSTITUENTS  
UNDERGROUND STORAGE TANK AREA  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA



OHM Corporation

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OHM CORPORATION  
WALNUT CREEK, CA

PLOT SCALE: 1"=50'

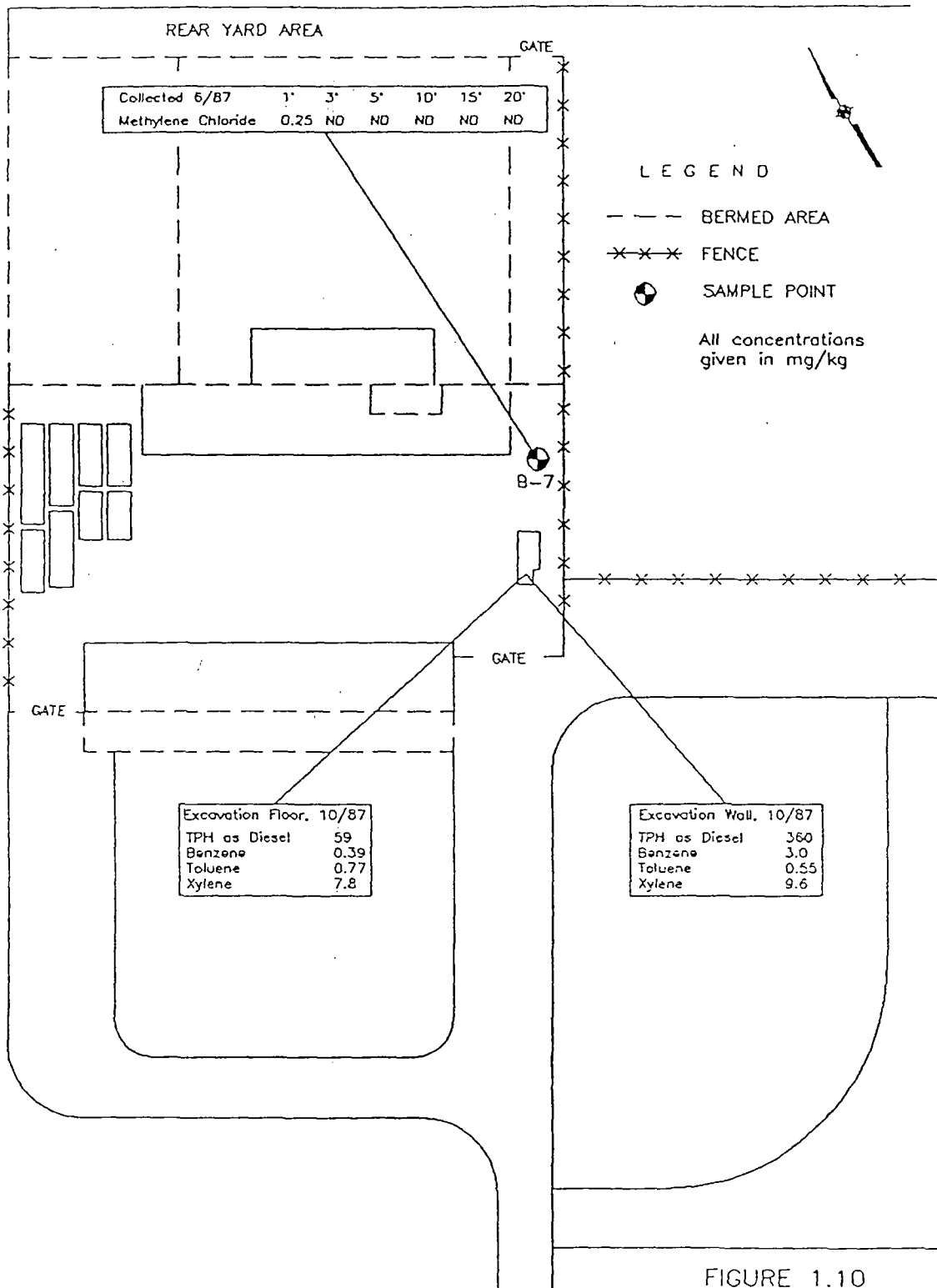


FIGURE 1.10  
DISTRIBUTION OF TARGET CONSTITUENTS  
FORMER UNDERGROUND DIESEL TANK  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR



OHM Corporation

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

DRAWING NUMBER 0007403-A4.9

APPROVED BY

CHECKED BY

DRAWN BY

E. Kwong 12-11-90

OHM CORPORATION  
WALNUT CREEK, CA

PLOT SCALE: 1"=50'

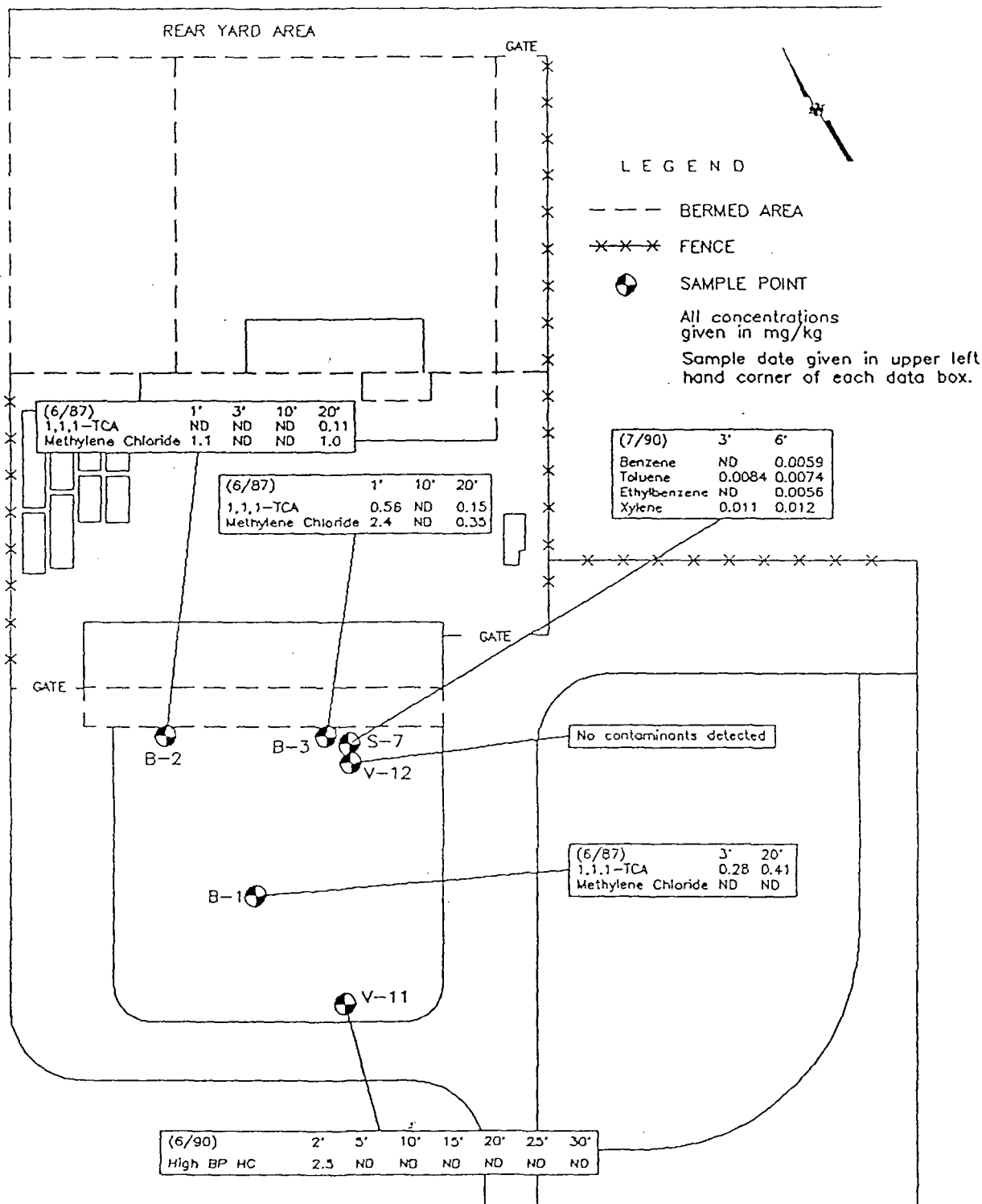


FIGURE 1.11  
DISTRIBUTION OF TARGET CONSTITUENTS  
DRUM STORAGE & BACKGROUND AREA  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA



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WALNUT CREEK, CA  
E. Kwong 12-11-90

PLOT SCALE: 1" = 110'

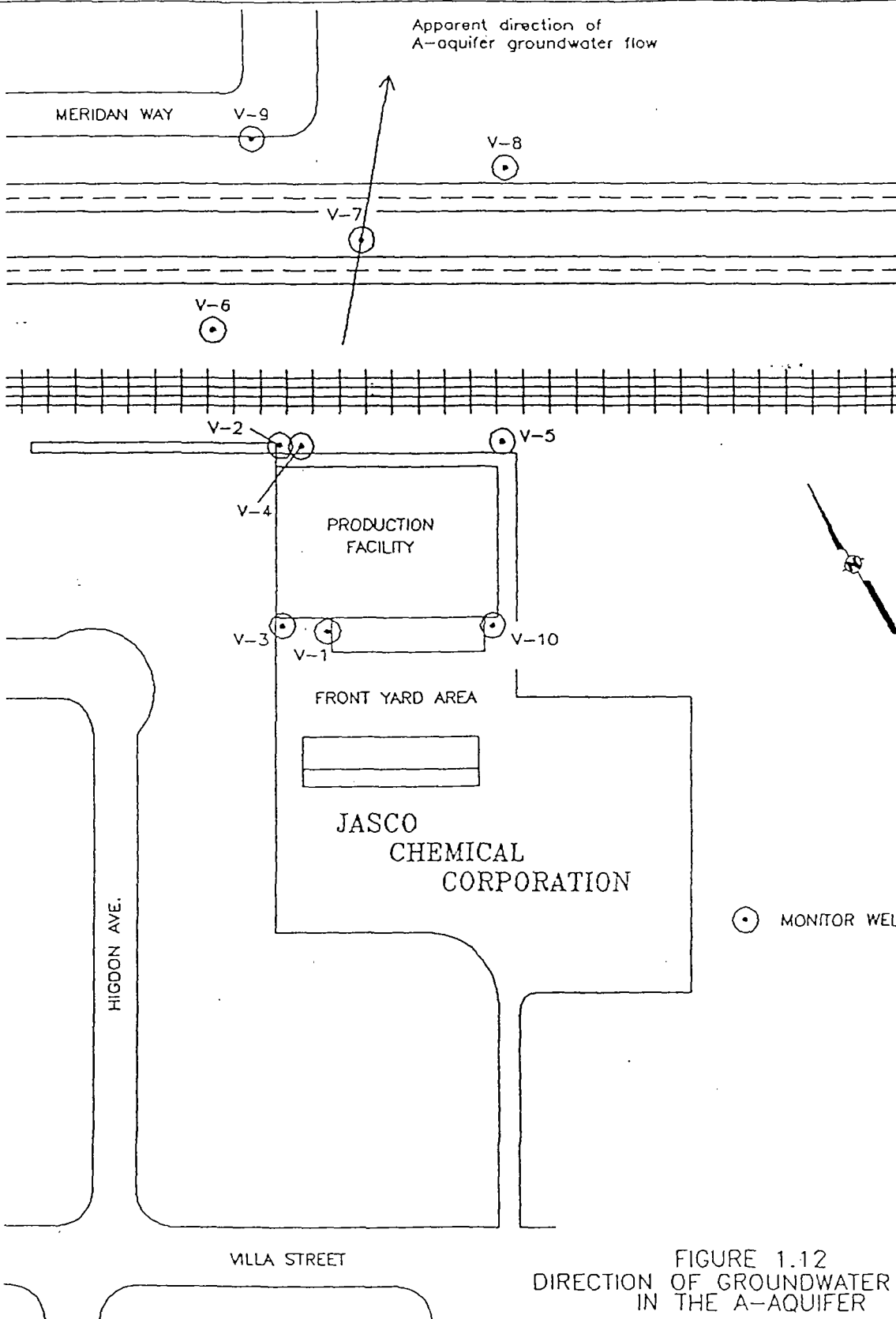


FIGURE 1.12  
DIRECTION OF GROUNDWATER FLOW  
IN THE A-AQUIFER

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CALIFORNIA



OHM Corporation

APPENDIX A  
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## APPENDIX B

### SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES, 1984 TO 1991



Table A-1  
Summary of Groundwater Analytical Results – Monitor Well V-1 (mg/l)

Constituent	July 1984	Nov 1986	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988	Jan 1989	Sept 1989	Dec 1989
<b>Volatile Organics (EPA methods 601/624)</b>											
1,1,1-Trichloroethane	0.009	na	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	na	na	<0.0005	0.0039	0.004	0.005	0.0066	0.0043	<0.002	0.0037	0.0032
1,1-Dichloroethene	na	na	<0.0005	0.0058	0.0007	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroethane	na	na	<0.0005	<0.0005	0.0031	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	na	0.018	<0.0005	<0.0005	0.0014	0.026	<0.01	<0.01	<0.002	0.014	<0.002
Trans-1,2-DCE	na	na	na	0.0014	0.0016	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
<b>Non-Halogenated Volatile Organics (EPA method 8015)</b>											
Acetone	0.098	na	<1.0	<0.05	0.014	<0.01	0.98	<0.01	<0.01	<0.015	<0.015
Ethanol	<0.02	na	<1.0	<0.05	<0.01	<0.01	0.55	na	<0.01	0.16	<0.05
Isopropanol	<0.030	na	<1.0	<0.05	<0.01	<0.01	0.44	na	<0.01	<0.02	<0.02
Methanol	0.095	na	<1.0	<0.05	<0.01	<0.01	1.4	na	<0.05	0.2	<0.06
Methyl ethyl ketone	0.004	na	<0.0005	<0.0005	<0.001	na	na	na	na	na	na
High Boiling Pt. HC	na	na	<1.0	<1.0	0.36	<0.05	<1.0	<1.0	0.15	0.2	0.3
TPH as paint thinner	0.86	na	<1.0	<1.0	na	na	<1.0	<1.0	na	na	na
<b>Phenols (EPA method 604)</b>											
4-Nitrophenol	na	na	<0.001	<0.01	<0.005	<0.015	<0.05	<0.01	<0.05	<0.02	<0.04
Pentachlorophenol	0.0002	na	<0.001	<0.01	<0.01	<0.01	<0.05	<0.025	<0.05	<0.02	<0.04

na – Analyses not conducted.

Table A-1 (cont.)  
Summary of Groundwater Analytical Results – Monitor Well V-1 (mg/l)

Constituent	Jan 1990	April 1990	July 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
<b>Volatile Organics (EPA methods 601/624)</b>								
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
1,1-Dichloroethane	0.0052	0.0082	0.0056	0.0021	0.0039	0.0037	<0.005	0.0031
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Chloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Methylene Chloride	<0.002	0.0068	0.017	0.0077	0.0058	<0.005	0.0564	<0.005
Trans-1,2-DCE	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
<b>Non-Halogenated Volatile Organics (EPA method 8015)</b>								
Acetone	0.038	<0.015	<0.015	<0.015	<0.015	<0.05	<0.05	<0.015
Ethanol	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.050
Isopropanol	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.020
Methanol	<0.06	<0.06	<0.06	<0.06	<0.06	<0.25	<0.25	<0.060
Methyl ethyl ketone	na	na	na	na	na	na	na	na
High Boiling Pt. HC	1.1	0.97	0.61	<0.05	<0.05	0.21	0.2	0.45
TPH as paint thinner	na	na	na	na	<0.05	0.12	0.25	0.16
<b>Phenols (EPA method 604)</b>								
4-Nitrophenol	<0.02	0.037	<0.02	<0.02	<0.02	<0.002	<0.002	<0.002
Pentachlorophenol	<0.02	0.023	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01

na – Analyses not conducted.

Table A-2  
Summary of Groundwater Analytical Results – Monitor Well V-2 (mg/l)

Constituent	Nov 1986	Aug 1987	Aug 1987	Sept 1987	Sept 1987
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	na	0.2	0.25	0.5	0.63
1,1-Dichloroethane	na	0.63	0.63	0.7	0.49
1,1-Dichloroethene	na	<0.05	<0.05	0.076	<0.05
Chlorobenzene	na	<0.05	<0.05	0.037	<0.05
Chloroethane	na	<0.05	<0.05	0.026	<0.05
Methylene Chloride	142	1.7	0.27	4.6	0.22

Non-Halogenated Organics (EPA method 8015)

Acetone	na	na	<1	na	0.95
Methyl ethyl ketone	na	<0.2	<0.05	0.027	<0.05

Purgeable Aromatics (EPA method 602)

Benzene	na	0.02	<0.05	0.007	<0.05
Toluene	na	0.25	<0.05	0.2	<0.05
Xylenes	na	0.05	<0.05	0.044	0.026

na – Analyses not conducted.

Note: Monitor well V-2 has been abandoned.

Table A-3  
Summary of Groundwater Analytical Results – Monitor Well V-3 (mg/l)

Constituent	Nov 1986	Jan 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989
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**Volatile Organics (EPA methods 601/624)**

1,1,1-Trichloroethane	<0.0005	<0.0005	0.0018	0.0011	0.0008	<0.002	<0.002	<0.002	<0.002	0.0026	0.0022
1,1-Dichloroethane	na	<0.0005	0.015	0.0066	0.008	0.0042	0.0064	0.003	0.0078	0.008	0.0064
1,1-Dichloroethene	na	<0.0005	0.0013	0.00076	0.0008	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane	na	<0.0005	0.001	<0.0005	<0.0005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	0.0076	<0.0005	0.0063	0.012	0.0008	<0.002	<0.01	<0.01	0.0021	0.29	0.011
Trans-1,2-Dichloroethene	na	0.004	0.012	0.0091	0.004	0.0048	0.0021	<0.002	0.0032	0.2	<0.002
Vinyl Chloride	na	<0.0005	<0.0005	0.00068	0.0006	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	na	na	<0.0005	<0.0005	<0.005	<0.005	<0.002	<0.002	0.011	<0.002	<0.002
Xylenes	na	na	0.008	<0.0005	<0.001	na	<0.002	<0.002	0.003	<0.002	<0.002

**Non-Halogenated Volatile Organics (EPA method 8015)**

Acetone	<1.0	<1.0	<1.0	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.015	0.036
Ethanol	<1.0	<1.0	<1.0	<0.05	<0.01	<0.01	<0.01	na	<0.01	2.7	<0.05
Methanol	0.0027	<0.001	<1.0	<0.05	<0.01	<0.01	<0.01	na	<0.01	0.31	<0.06
TPH as Diesel	na	na	<1.0	<1.0	20	<0.05	<1.0	5.8	6.2	33	0.92
TPH as Paint Thinner	na	na	na	na	na	na	na	na	na	na	na

**Semi-Volatile Organics (EPA method 8270)**

Pentachlorophenol	0.05	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.002	<0.002	<0.02
1-[2-(2-Methoxy-1-Methoxy)-1-Methoxy]-2-Propanol	na	na	na	na	na	na	na	na	0.39	na	na
4-Butoxybutanoic Acid	na	na	na	na	na	na	na	na	0.049	na	na

na – Analyses not conducted.

Table A-3 (cont.)  
Summary of Groundwater Analytical Results – Monitor Well V-3 (mg/l)

Constituent	Jan 1990	April 1990	July 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	0.0026
1,1-Dichloroethane	0.0047	0.0033	0.0023	<0.002	0.0042	0.0034	<0.005	0.0072
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
1,2-Dichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Methylene Chloride	0.014	0.053	0.0064	<0.002	<0.002	<0.002	0.0367	<0.002
Trans-1,2-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Benzene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002
Xylenes	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.002

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	0.02	<0.01	<0.01	<0.01	<0.15	<0.05	<0.05	<0.15
Ethanol	<0.05	<0.05	<0.05	<0.05	<0.15	<0.05	<0.05	<0.15
Methanol	3.8	<0.06	<0.06	<0.06	<0.3	<0.25	<0.25	<0.3
TPH as Diesel	0.25	0.27	0.15	<0.05	<0.05	<0.05	0.3	<0.05
TPH as Paint Thinner	na	na	na	na	<0.05	<0.05	0.37	<0.05

Semi-Volatile Organics (EPA method 8270)

Pentachlorophenol	<0.01	<0.01	<0.01	<0.01	<0.011	<0.01	<0.01	<0.01
1-[2-(2-Methoxy-1-Methoxy)-1-Methoxy]-2-Propanol	na	na	na	na	na	na	na	na
4-Butoxybutanoic Acid	na	na	na	na	na	na	na	na

na – Analyses not conducted.

Table A-4  
Summary of Groundwater Analytical Results – Monitor Well V-4 (mg/l)

Constituent	April 1987	May 1987	June 1987	Aug 1987	Sept 25 1987	Sept 27 1987	Jan 1988	March 1988	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	1.3	0.39	0.17	0.06	0.03	0.02	0.25	0.14	0.086	0.054	0.99	0.069	1.7
1,1-Dichloroethane	2.2	1.2	0.5	0.4	0.31	1.0	0.53	0.36	0.25	0.23	0.68	0.27	7.8
1,1-Dichloroethene	0.17	0.14	0.15	0.036	0.014	0.028	0.063	0.06	0.045	0.042	0.066	0.033	0.19
1,2-Dichloroethane	<0.01	<0.005	0.0005	<0.005	<0.005	0.008	0.0041	<0.004	<0.002	<0.002	<0.002	<0.002	<0.1
trans 1,2-Dichloroethen	<0.01	<0.005	0.0066	<0.005	<0.005	na	<0.005	<0.004	<0.002	<0.002	<0.02	<0.002	<0.1
Bromoform	<0.01	<0.005	0.0005	<0.005	<0.005	na	0.003	<0.004	<0.002	<0.002	<0.02	<0.002	<0.1
Chlorobenzene	na	na	0.0005	<0.005	<0.005	0.008	<0.005	<0.004	<0.002	<0.002	<0.02	<0.002	<0.1
Chloroethane	0.16	0.012	0.065	<0.005	0.039	0.059	0.028	0.012	0.013	0.016	<0.02	0.013	0.39
Dibromochloromethane	<0.01	<0.005	0.0005	<0.005	<0.005	na	0.0026	<0.004	<0.002	<0.002	<0.02	<0.002	<0.1
Methylene Chloride	1.4	0.49	0.11	<0.005	<0.005	0.003	0.21	0.031	<0.01	<0.01	0.55	<0.002	3.5
Toluene	na	na	0.0038	<0.005	<0.005	0.017	0.014	<0.004	<0.002	<0.002	<0.02	<0.002	<0.1
Vinyl Chloride	0.011	<0.005	0.016	<0.005	<0.005	na	0.01	<0.004	<0.002	<0.002	<0.02	0.0026	<0.1

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	na	na	na	<1.0	<0.05	na	0.018	<0.05	<0.01	<0.01	<0.01	<0.01	1.7
Ethanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01	<0.01	na	na	<0.05	16
Isopropanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01	<0.01	na	na	<0.06	1.4
Methanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01	<0.01	na	na	0.73	0.17
TPH as diesel	na	na	na	<1.0	<1.0	na	2.2	<0.05	<1.0	<1.0	0.27	0.082	2.1
TPH as paint thinner	na	na	na	na	na	na	na	na	na	na	na	na	na

Phenols (EPA method 604)

Phenol	na	na	na	<0.001	<0.01	na	<0.01	<0.01	<0.002	0.0032	<0.002	<0.002	<0.004
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na – Analyses not conducted.

Table A-4 (cont.)  
Summary of Groundwater Analytical Results – Monitor Well V-4 (mg/l)

Constituent	Jan 1990	April 1990	July 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	0.14	0.041	0.048	0.042	0.028	0.07	0.0461	0.094
1,1-Dichloroethane	0.29	0.23	0.24	0.14	0.26	0.31	0.329	0.65
1,1-Dichloroethene	0.029	0.021	0.038	<0.005	0.014	0.038	0.0254	0.027
1,2-Dichloroethane	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
trans 1,2-Dichloroethen	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
Bromoform	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
Chlorobenzene	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
Chloroethane	0.0066	0.0061	0.012	<0.005	0.023	0.0074	<0.005	0.011
Dibromochloromethane	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
Methylene Chloride	0.015	0.005	<0.002	<0.005	<0.004	<0.005	0.0054	0.15
Toluene	<0.004	<0.004	<0.002	<0.005	<0.004	<0.005	<0.005	<0.01
Vinyl Chloride	0.0054	0.0053	0.005	<0.005	<0.004	0.0064	<0.005	<0.01

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	0.1	<0.01	<0.01	<0.01	<0.15	<0.050	<0.050	<0.015
Ethanol	0.2	<0.05	<0.05	<0.05	<0.15	<0.050	<0.050	<0.050
Isopropanol	<0.02	<0.02	<0.02	<0.02	<0.15	<0.050	<0.050	<0.020
Methanol	<0.06	<0.06	<0.06	<0.06	<0.3	<0.25	<0.25	<0.060
TPH as diesel	0.12	0.24	0.35	<0.05	<0.05	0.16	0.51	0.34
TPH as paint thinner	na	na	na	na	<0.05	0.094	0.62	0.13

Phenols (EPA method 604)

Phenol	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
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na – Analyses not conducted.

Table A-5  
Summary of Groundwater Analytical Results – Monitor Well V-5 (mg/l)

Constituent	May 1987	June 1987	Aug 1987	Sept 1987	Jan 1988	March 1988
Non-Halogenated Volatile Organics (EPA method 8015)						
Acetone	<1.0	na	<1.0	<0.05	<0.01	<0.01

na – Analyses not conducted

Constituent	June 1988	Oct 1988	Jan 1989	Aug 1989	Jan 1990	July 1990
Non-Halogenated Volatile Organics (EPA method 8015)						
Acetone	0.12	<0.01	<0.01	<0.01	<0.01	<0.01

na – Analyses not conducted

Constituent	Jan 1991	July 1991	Nov 1991
Non-Halogenated Volatile Organics (EPA method 8015)			
Acetone	<0.01	<0.05	<0.05

na – Analyses not conducted



Table A-6  
Summary of Groundwater Analytical Results – Monitor Well V-6 (mg/l)

Constituent	May 1987	June 1987	Aug 1987	Sept 1987	Jan 1988	March 1988
Volatile Organics (EPA methods 601/624)						
1,1,1-Trichloroethane	<0.0038	<0.0005	0.0025	0.0045	0.0026	0.0032
Benzene	<0.0044	<0.0005	<0.0005	0.0019	<0.0005	<0.002

na – Analyses not conducted

Constituent	June 1988	Oct 1988	Jan 1989	Aug 1989	Jan 1990	July 1990
Volatile Organics (EPA methods 601/624)						
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na – Analyses not conducted

Constituent	Jan 1991	July 1991	Nov 1991
Volatile Organics (EPA methods 601/624)			
1,1,1-Trichloroethane	<0.002	<0.002	<0.002
Benzene	<0.002	<0.002	<0.002

na – Analyses not conducted

Table A-7  
Summary of Groundwater Analytical Results – Monitor Well V-7 (mg/l)

Constituent	May 1987	June 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.064	0.028	0.016	0.023	0.012	0.018	0.013	0.031
1,1-Dichloroethane	0.055	0.049	0.024	0.019	0.014	0.029	0.028	0.01
1,1-Dichloroethene	0.0077	<0.0002	0.0019	0.0024	0.0035	0.0081	0.006	0.0029
Acetone	<1.0	na	<1.0	<0.050	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	0.005	<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002
Chloroform	<0.0016	<0.0005	<0.0005	<0.0005	0.0007	<0.01	<0.01	<0.01
Methylene Chloride	<0.0028	<0.0005	<0.0005	<0.0005	<0.0005	<0.01	<0.01	<0.01
Vinyl Chloride	<0.005	<0.0005	<0.0005	<0.0005	0.0012	<0.002	<0.002	<0.002

na – Analyses not conducted.

Constituent	Jan 1989	Jan 1989	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.0087	0.012	0.0067	<0.002	0.0033	0.0043	0.0034	0.0064
1,1-Dichloroethane	0.016	0.02	0.012	0.005	0.015	0.013	0.0075	0.0094
1,1-Dichloroethene	0.0043	0.007	0.0033	<0.002	0.0034	0.0037	0.0032	<0.002
Acetone	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroform	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	<0.002	<0.002	0.0048	0.0048	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na – Analyses not conducted.

Constituent	Jan 1991	April 1991	July 1991	Nov 1991
Volatile Organics (EPA methods 601/624)				
1,1,1-Trichloroethane	0.0078	0.0035	na	0.0038
1,1-Dichloroethane	0.03	0.012	na	0.015
1,1-Dichloroethene	0.0075	0.0042	na	0.0031
Acetone	<0.01	<0.01	na	<0.01
Carbon Tetrachloride	<0.002	<0.002	na	<0.002
Chloroform	<0.002	<0.002	na	<0.002
Methylene Chloride	<0.002	<0.002	na	<0.002
Vinyl Chloride	<0.002	<0.002	na	<0.002

na – Analyses not conducted.

Table A-8  
Summary of Groundwater Analytical Results – Monitor Well V-8 (mg/l)

Constituent	March 8 1988	March 22 1988	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1990
Volatile Organics (EPA method 601/624)								
1,1,1-Trichloroethane	0.0035	0.0037	0.0026	0.0024	0.004	0.0028	0.0025	0.0026
1,1-Dichloroethane	<0.002	0.00069	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene	<0.002	0.00065	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Propanone	0.003	na	na	na	na	na	na	na
Acetone	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010

na – Analyses not conducted.

Constituent	April 1990	July 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
Volatile Organics (EPA method 601/624)							
1,1,1-Trichloroethane	0.0026	0.0031	0.002	0.0021	<0.002	na	<0.002
1,1-Dichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
2-Propanone	na	na	na				
Acetone	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.033

na – Analyses not conducted.

Table A-9  
Summary of Groundwater Analytical Results – Monitor Well V-9 (mg/l)

Constituent	Mar 8 1988	Mar 22 1988	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	<0.002	0.0022	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.0036	0.0039	0.0031	0.0039	0.0028	0.0027	0.0029	0.0028
2-Propanone	0.0051	na	na	na	na	na	na	na
Toluene	<0.002	<0.0005	<0.002	<0.002	<0.002	<0.002	0.0023	<0.002
Non Halogenated Volatile Organics (EPA Method 8015)								
Methanol	<0.01	na	0.54	na	na	<0.06	<0.06	<0.06

na – Analyses not conducted.

Constituent	April 1990	July 1990	Oct 1990*	Jan 1991*	April 1991*	July 1991*	Nov 1991*
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	<0.002	<0.002	na	na	na	na	na
1,1-Dichloroethane	0.0026	0.0026	na	na	na	na	na
2-Propanone	na	na	na	na	na	na	na
Toluene	<0.002	<0.002	na	na	na	na	na
Non Halogenated Volatile Organics (EPA Method 8015)							
Methanol	<0.06	<0.06	na	na	na	na	na

na – Analyses not conducted.

\* – well dry; no sample collected

Table A-10  
Summary of Groundwater Analytical Results – Monitor Well V-10 (mg/l)

Constituent	Mar 9 1988	Mar 22 1988	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	<0.002	0.0009	<0.002	<0.002	<0.02	<0.002	<0.002	<0.002
Methylene Chloride	<0.01	0.0005	<0.01	<0.01	2.0	<0.002	<0.002	0.003
Non-Halogenated Volatile Organics (EPA method 8015)								
Acetone	<0.01	na	1.3	0.023	<0.01	<0.015	<0.01	<0.01
Ethanol	<0.01	na	0.17	na	<0.01	<0.05	<0.05	<0.05
Isopropanol	<0.01	na	0.33	na	<0.01	<0.02	<0.02	<0.02

na – Analyses not conducted.

Constituent	April 1990	July 1990	Oct 1990	Jan 1991 *	April 1991 *	July 1991 *	Nov 1991 *
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	na	na	na	na
Methylene Chloride	0.0039	<0.002	<0.002	na	na	na	na
Non-Halogenated Volatile Organics (EPA method 8015)							
Acetone	<0.01	<0.01	<0.01	na	na	na	na
Ethanol	<0.05	<0.05	<0.05	na	na	na	na
Isopropanol	<0.02	<0.02	<0.02	na	na	na	na

na – Analyses not conducted.

\* – well dry; no sample collected

Constituent	June 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
No target constituents were detected exceeding the minimum detection limit						

Constituent	June 1990	Oct 1990	Jan 1991	April 1991	July 1991	Nov 1991
No target constituents were detected exceeding the minimum detection limit						

Table A-13  
Summary of Groundwater Analytical Results – Monitor Well I-1 (mg/l)

Constituent	May 1987	June 3 1987	June 22 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	<0.0038	<0.005	<0.005	0.0019	0.002	0.0021	<0.002	<0.002
1,1-Dichloroethane	0.011	0.0039	<0.005	0.0023	0.003	0.0012	0.0029	<0.002
Acetone	na	na	na	<1.0	<0.05	<0.01	<0.01	0.13
Methylene Chloride	<0.0028	<0.005	0.032	<0.0005	<0.0005	<0.0005	<0.01	<0.01

na – Analyses not conducted.

Constituent	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1989	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.0021	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	<0.002	0.0026	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Acetone	0.024	<0.01	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	<0.01	<0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na – Analyses not conducted.

Constituent	Jan 1991	April 1991	July 1991	Nov 1991
Volatile Organics (EPA methods 601/624)				
1,1,1-Trichloroethane	<0.002	<0.002	na	<0.002
1,1-Dichloroethane	<0.002	<0.002	na	<0.002
Acetone	<0.01	<0.01	na	<0.01
Methylene Chloride	<0.002	<0.002	na	<0.002

na – Analyses not conducted.

Table A-14  
Summary of Groundwater Analytical Results – Monitor Well I-2 (mg/l)

Constituent	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988	Jan 1989
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	0.0068	<0.0005	0.0032	0.003	0.0039	0.0038	0.0028
1,1-Dichloroethane	0.014	<0.0005	0.01	0.0045	0.0051	0.0037	0.0036
1,1-Dichloroethene	0.0071	<0.0005	0.003	0.0024	0.0029	<0.002	0.0021
Acetone	na	<0.05	<0.01	<0.01	<0.01	0.019	<0.01

na – Analyses not conducted.

Constituent	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990	Jan 1991
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	0.0027	0.0036	0.0032	0.0022	0.003	<0.002	0.0024
1,1-Dichloroethane	0.0035	0.0046	0.0029	0.0025	0.003	<0.002	0.0023
1,1-Dichloroethene	0.0023	0.0026	<0.002	<0.002	0.0022	<0.002	<0.002
Acetone	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

na – Analyses not conducted.

Constituent	April 1991	July 1991	Nov 1991
Volatile Organics (EPA methods 601/624)			
1,1,1-Trichloroethane	<0.002	na	0.0031
1,1-Dichloroethane	<0.002	na	0.0027
1,1-Dichloroethene	<0.002	na	<0.002
Acetone	<0.01	na	<0.01

na – Analyses not conducted.



Table A-15  
Summary of Groundwater Analytical Results – Monitor Well I-3 (mg/l)

Constituent	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988
Volatile Organics (EPA methods 601/624)						
Vinyl Chloride	<0.0005	<0.0005	0.004	<0.002	<0.002	<0.002
Phenols (EPA method 8040)						
Phenol	na	0.02	<0.01	<0.01	<0.002	<0.003

na – analyses not conducted

Constituent	Jan 1989	Aug 1989	Jan 1990	July 1990	Jan 1991	July 1991
Volatile Organics (EPA methods 601/624)						
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002	na
Phenols (EPA method 8040)						
Phenol	<0.002	<0.002	<0.002	0.0036	<0.002	<0.002

na – analyses not conducted

Constituent	Nov 1991
Volatile Organics (EPA methods 601/624)	
Vinyl Chloride	<0.002
Phenols (EPA method 8040)	
Phenol	<0.002

na – analyses not conducted

APPENDIX C

ENDANGERMENT ASSESSMENT

APPENDIX  
D

**Remediation Levels for Soils  
at the Jasco Chemical Corporation Site  
in Mountain View, California**

**Prepared for:**

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**February 27, 1991  
Project 7403**

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## 1.0 INTRODUCTION

This report provides justification for site-specific cleanup levels for chemicals in soils at the Jasco facility in Mountain View, California. These cleanup levels were developed based on the Endangerment Assessment prepared for the site by Jacobs Engineering Inc (Jacobs 1989). The Endangerment Assessment (EA) addresses the potential threat to human health (Human Health Evaluation) and the environment (Environmental Assessment) posed by contamination present at the site.

The Jasco Chemical Corp. (Jasco) Site in Mountain View, CA is on EPA's National Priority List (NPL; Superfund Site List) of hazardous waste sites. Jacobs prepared the EA for the Jasco Site under a Technical Enforcement Support (TES) contract with EPA. The EA was prepared in August 1989, prior to release of EPA's Risk Assessment Guidance on Human Health Assessment (EPA 1989; Interim Final) and was prepared using the older Superfund Public Health Evaluation Manual (EPA 1986).

EPA is currently in the process of developing guidance on the preparation of site-specific cleanup levels. Several internal drafts have been prepared but EPA has not released an external draft. In general terms, it appears that the draft guidance will involve back-calculating cleanup levels based on a site-specific risk assessment.

The cleanup levels developed by OHM for the Jasco site were developed based on the site-specific risk assessment (EA) prepared for the site. OHM followed standard risk assessment procedures as outlined in the EPA (1989a) Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A (Interim Final). Other supporting documents used for guidance included the EPA (1988) Superfund Exposure Assessment Manual, the EPA (1989b) Exposure Factors Manual, and the California Leaking Underground Fuel Tank (LUFT) Manual (CRWQCB 1989).

Section 2 of the report contains background information on the site and describes the nature and extent of contamination. The next section presents information on the environmental behavior and toxicity of key chemicals. As part of the toxicological assessment, health-based criteria are identified. Section 4 contains a discussion of exposure pathways, the calculation of cleanup levels, and a consideration of background concentrations and cleanup levels that have been used at other facilities. The final cleanup levels and the conclusions of the assessment are presented in Section 5.

## 2.0 SITE CHARACTERIZATION

This section of the risk assessment contains a brief description of the location, topography, meteorology, and climate of the site. A summary of the nature and extent of contamination is also included. More detailed information on the nature and extent of contamination are provided in the Remedial Investigation and the Feasibility Study.

### 2.1 SITE BACKGROUND

Jasco Chemical Company operates a bulk chemical repackaging and blending facility at 1710 Villa Street in Mountain View, California (Figure 1). This facility has been in operation since December 1976. Prior to use of the property by Jasco, the site was operated by West Coast Doors, Inc., for manufacturing and painting of commercial and residential doors. The site was rezoned from industrial to residential in December 1983 and Jasco will have to vacate the premises sometime in the near future.

Extensive investigations have been conducted at the site over the past 6 years. These activities are documented in the draft Remedial Investigation report (OHM 1990). These investigations showed the presence of petroleum hydrocarbon products including paint thinner, diesel fuel, and kerosene, and volatile organic compounds including: acetone, 1,2-dichloroethane, 1,1-dichloroethylene, methylene chloride, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, benzene, toluene, and xylene. Pentachlorophenol was also detected in a soil sample from the site.

Jasco has initiated several interim remedial measures at the site. In October and November 1988, Jasco removed over 550 cubic yards of soil from the northern side of the facility at the eastern side of the drainage swale and refilled the excavation with lean concrete. The excavation extended to a depth of 22 to 28 feet based upon the results of on-site OVA analyses and the depth of the water table (approx 28-30 feet). Confirmation samples were collected at the bottom of the excavation and showed levels of chemicals that were up to four orders of magnitude less than pre-excavation sample results. A more detailed discussion of the excavation program can be found in "Interim Remedial Measures, October through November, 1988," prepared by Harding Lawson Associates.

Jasco is also operating a groundwater extraction system at the north side of the main plant building. This groundwater extraction system is installed in well V-4 and has been pumping at a low flow rate (to limit drawdown) since April 1987. Water samples for laboratory analyses are collected monthly to ensure that concentrations of constituents do not exceed target limits established by the city of Mountain View.

In June of 1988, the site was proposed for the EPA Superfund Amendments and Reauthorization Act (SARA) National Priority List (NPL; Superfund); it was subsequently placed on the NPL. As part of an investigation at an NPL site, an Endangerment Assessment (EA) must be prepared to evaluate whether or not the site poses an imminent and substantial endangerment to public health, welfare, or the environment. This EA can also be used as the basis for establishing remediation goals. An Endangerment Assessment for the Jasco site was prepared by Jacobs Engineering Group, Inc. (Jacobs 1989). The Jacobs EA was used as the basis for this cleanup level determination report.

## 2.2 DEMOGRAPHICS

The City of Mountain View has a population of 58,655 and is located within the San Jose metropolitan area which has a population of approximately 1.3 million. The site is surrounded to the south, west and east by multi-unit residential property. To the north the site abuts property owned and operated by Southern Pacific Railroad (SP). This property is used for commuter and freight rail transport. To the north of the SP property lies the Central Expressway and additional residential property.

## 2.3 ENVIRONMENTAL CHARACTERIZATION

The site slopes gently to the north towards San Francisco Bay from an elevation of about 64 feet above mean low water (MLW) at the southern property boundary to about 58 feet MLW just north of the Central Expressway. The loading area and parking areas, the driveways and all buildings are surfaced with concrete or pavement and the majority of the site is fenced. The area of the drainage swale is not adequately fenced.

The climate of the Mountain View area is characterized by mild, wet winters and warm, dry summers. Data on precipitation in the area was collected between 1974 and 1982 at the Mountain View Corporation Yard which is located about 1.6 miles east of the JASCO facility. Average monthly rainfall at the Mountain View site ranges from a low of 2.2 mm (0.09 inches) in June to a high of about 76.8 mm (3.0 inches) in January. Nearly 75 percent of the precipitation falls between the months of December and March. The average seasonal rainfall is 320.4 mm (12.7 inches). Evaporation data collected monthly by the California Department of Water Resources indicates that the average seasonal evaporation rate is approximately 119 mm (4.7 inches) per year.

### 2.3.1 Hydrology

Surface water runoff in the vicinity of the Jasco site is directed to storm sewer lines which discharge to Permanente Creek. Permanente Creek, located 600 feet to the west of the site, is the nearest surface water body to the Jasco facility. In the vicinity of the site Permanente Creek is a concrete lined drainage approximately ten feet deep. No other surface water bodies are located within one mile of the Jasco facility.

### 2.3.2 Geology

The geology of the site consists of medium and fine-grained alluvium. This material is characteristic of a mid to distal alluvial fan depositional environment and is composed of poorly to moderately sorted, irregularly to well-bedded, low to moderately permeable deposits of clay, silt and clayey silt with occasional beds and lenses of fine to coarse sand. These deposits are Holocene in age (0 to 5,000 years old) and are generally less than 21 feet thick.

On the northern side of the site in the vicinity of the drainage swale lithologic data shows that the upper five to twelve feet consists of clay and clayey sand. This layer is underlain by interbedded silt and silty sand to a depth of approximately 15 feet. This silt bed is unconformably underlain by a thin but continuous 1 to 2 foot thick bed of poorly sorted coarse sand. This coarse sand bed appears to increase in thickness to the east and may represent an ancestral stream channel. Between the depths of 16 feet and 28 feet the lithology consists of interbedded sand, silt, and clay. From the depth of about 28 feet to the total depth of the boreholes the lithology was predominantly sand and gravel representing the A-aquifer.



### 2.3.3 Hydrogeology

Three water bearing zones have been identified beneath the site and have been designated as the A-, B(1)-, and B(2)-aquifers in order of increasing depth. The current groundwater monitoring network consists of eleven A-aquifer and three B(1)-aquifer wells. The A-aquifer, encountered between 25 and 35 feet is of variable thickness and is under confined conditions. The B(1)-aquifer, encountered between 47 and 56 feet, is separated from the A-aquifer by a clayey aquitard about seven feet thick. The B(2)-aquifer was encountered at one boring at a depth of 57 feet.

Permeability data collected during this investigation provided information concerning the effectiveness of confining layers and aquitards. The permeability of the confining layer over the A-aquifer as measured at a depth of between 12 and 14 feet below grade was  $2.4 \times 10^{-4}$  cm/sec. The high values for this layer are attributed to the presence of root casts. The permeability of the aquitards separating the A-aquifer and B(1)-aquifer as measured at a depth of between 26 and 40 feet ranged from  $2.8 \times 10^{-6}$  to  $3.1 \times 10^{-7}$  cm/sec. The permeability of the aquitards beneath the B(1)-aquifer as measured at a depth of 56 to 58 feet below grade ranged from  $2.9 \times 10^{-7}$  to  $2.3 \times 10^{-8}$  cm/sec ( $5.7 \times 10^{-7}$  to  $4.5 \times 10^{-8}$  ft/min).

The direction of groundwater flow in the A- and B(1)-aquifers is predominantly to the north-northeast (toward the San Francisco Bay) at a gradient of approximately 0.004 ft/ft (vertical feet per linear foot). The direction of groundwater flow in the B(2)-aquifer is presumed to be in a similar direction as the two shallower aquifers. Groundwater flow within the A-aquifer has been affected by the extraction of groundwater from monitor well V-4. The groundwater flow pattern also suggests that flow within the A-aquifer in the vicinity of the site may be preferentially along the path of an ancestral stream channel. Flow within the B(1)-aquifer is in a more regional and predominantly northerly direction.

The average value of the horizontal hydraulic conductivity of the A-aquifer as measured by the constant rate discharge test at monitor well V-4 was  $7.9 \times 10^{-2}$  ft/min. This figure is an average of calculations based upon the Hantush-Jacob method for leaky confined aquifers, the Jacob straight line method for bounded aquifers with a short distance between the pumping and observation well, and the Jacob solution for recovery data. The average value of transmissivity was  $5.53 \times 10^{-2}$  ft<sup>2</sup>/min and the average value of storativity was  $1.52 \times 10^{-3}$ . The slug test yielded variable values of aquifer parameters in the vicinity of the other A-aquifer monitor wells. Transmissivity ranged from a high of  $7.18 \times 10^{-1}$  ft<sup>2</sup>/min at monitor well V-6 to a low of  $1.98 \times 10^{-3}$  ft<sup>2</sup>/min at monitor well V-5. The values for hydraulic conductivity followed a similar pattern with a high of  $1 \times 10^{-1}$  ft/min at monitor well V-6 and a low of  $6 \times 10^{-4}$  ft/min at monitor well V-5. Values of storativity ranged from a high of  $3.67 \times 10^{-2}$  at monitor well V-2 to a low of  $5.88 \times 10^{-10}$  at monitor well V-1.

## 2.4 NATURE AND EXTENT OF CONTAMINATION

Numerous studies have been used to characterize the nature and extent of contamination at the site. A detailed description of these investigations and their results is presented in the draft Remedial Investigation (OHM 1990) and in the Feasibility Study (OHM 1991). Maximum concentrations detected at the site in soil and groundwater are presented in Tables 1 and 2, respectively. Figures 1 through 4 present concentrations detected at sampling locations across the site. The total mass of soil that is estimated to be contaminated is 750 cubic yards.

#### 2.4.1 Soil

Chemicals are present in site soils but except in a few hotspots, are generally present at low levels and occur infrequently. The major area of contamination that was used as the basis for the Jacobs (1989) EA has been remediated. Concentrations detected in this area are presented in Figure 3. In the area of the drainage swale located north and east of the excavated site and bounded to the south by the concrete pad and to the north by the railroad ballast, target constituents were detected from the depth of three feet to the depth of groundwater (Figure 1). Maximum concentrations detected in this area are:

<u>CONSTITUENT</u>	<u>MAX. CONCENTRATION</u>	<u>DEPTH</u>
1,1-DCA	3.0 mg/kg	30'
1,1-DCE	1.7 mg/kg	5'
1,2-DCE	0.015 mg/kg	25'
1,1,1-TCA	61.0 mg/kg	5'
acetone	8.8 mg/kg(May,1988)	3'
bromoform	0.17 mg/kg	25'
methylene chloride	4.2 mg/kg	20'
tetrachloroethene	4.0 mg/kg	25'
trichloroethene	0.015 mg/kg	3'

These results are from analyses conducted between June and July of 1990 except for acetone which represents analyses conducted in May of 1988. Acetone was not detected in the June/July 1990 sampling round.

To the west of the excavated area, the presence of halogenated volatile organic constituents appears to be limited to an area extending from the block wall ten feet north and bounded to the east by the area of interim soil excavation and extending to the west approximately 160 feet. Figures 2 and 4 provide the concentrations and locations of samples collected in this area. Soil samples collected below a depth of three feet at the boreholes located greater than ten feet north of the block wall did not contain any halogenated volatile organic constituents. Maximum concentration detected in this area are:

<u>CONSTITUENT</u>	<u>MAX. CONC. (Date)</u>	<u>DEPTH</u>
1,1-DCA	0.61 mg/kg (5/88)	3'
1,1,1-TCA	0.44 mg/kg (5/88)	3'
methylene chloride	6.2 mg/kg (5/88)	3'
tetrachloroethylene	0.24 mg/kg (5/88)	3'

Of the samples collected from this area in the June/July 1990 sampling round, the only halogenated volatile organic constituents which were detected at concentrations above detection limits were tetrachloroethylene (0.005 mg/kg in S-5) and 1,1,1-TCA (0.014 mg/kg in C-3).

#### 2.4.2 Groundwater

Maximum concentrations of chemicals detected in groundwater at the site are presented in Table 2. In general, the greatest number and highest concentrations of chemicals have been detected in monitoring wells V-2 (which has been destroyed) and V-4, both of which are or were located at the northwest corner of the production facility (Figure 5). Monitoring wells V-1 and V-3 at the northern portion of the underground storage tank area and the southwestern corner of the production facility have the next highest levels of chemicals.

At present, based upon the results of analyses conducted in April and July of 1990, the only non-halogenated volatile organic constituent present in A-aquifer groundwater is high boiling point hydrocarbons. During July 1990, high boiling point hydrocarbons were only detected at monitor wells V-1 (0.65 mg/l), V-3 (0.15 mg/l), and V-4 (0.35 mg/l).

Pentachlorophenol and 4-Nitrophenol were detected in groundwater collected from monitoring well V-1 in April 1990 at concentrations of 0.023 mg/l and 0.037 mg/l, respectively. Samples collected from this well in July 1990 and prior to April 1990 did not contain detectable levels of these constituents, except that pentachlorophenol was detected at 0.0002 mg/l in July 1984. Pentachlorophenol was reportedly detected at 0.05 mg/l in well V-3 in November 1987 but was not detected at any other time in this well or in other wells.

The only target constituents detected in groundwater samples from the B(1)-aquifer during the July 1990 sampling were 1,1,1-trichloroethane (0.003 mg/l), 1,1-dichloroethane (0.003 mg/l), and 1,1-dichloroethene (0.002 mg/l) at monitoring well I-2 and phenol (0.0036 mg/l) at monitoring well I-3. Figure 6 provides the locations of these wells. No target constituents have been detected in groundwater samples collected from monitoring well I-1 located at the eastern edge of the former drainage swale area during the last four sampling phases. The presence of volatile organic constituents in groundwater collected from monitoring well I-2, directly downgradient from the former drainage swale area, has been relatively constant over recent sampling phases. Phenol was detected in the groundwater sample collected from monitoring well I-3 in July 1990 at a concentration of 0.0036 mg/l. Phenol had been detected at 0.02 mg/l in groundwater collected from this well in September 1987 but had not been detected in subsequent sampling rounds.

The source of the constituents in the B(1)-aquifer are uncertain. It is possible that target constituents may have migrated from potential source areas through the overlying vadose zone soil, the A-aquifer and the aquitard separating the A- and B(1)-aquifers. More likely migration pathways include the downward movement of A-aquifer groundwater along wells completed into the B(1)-aquifer at the time of installation or migration within wells with screened intervals which bridge the aquitard separating the two uppermost aquifers.

### 3.0 CHARACTERISTICS OF KEY CHEMICALS

The Jacobs (1989) EA identified the key site chemicals as:

Benzene	Tetrachloroethene
1,1-Dichloroethane	Trichloroethene
1,2 Dichloroethane	Vinyl Chloride
1,1-Dichloroethene	Pentachlorophenol
Methylene Chloride	

Further review of data collected subsequent to the EA suggests that 1,1,1-trichloroethane, which has been detected at elevated concentrations in groundwater and in soils should also be included as a key site chemical. Pentachlorophenol (PCP) has not been detected in site soils in any recent sampling and was only detected in one groundwater sample at a level slightly above detection limits. PCP was detected in this well in April 1990 but not in July 1990 and not in other sampling rounds. Based on its very infrequent detection and low concentration, the total mass of PCP would seem to be too low to pose a health concern. In addition, the Jacobs EA indicated that PCP did not pose a potential health risk under the scenarios considered in their assessment. Consequently, PCP will not be considered a key chemical for remediation.

Petroleum-derived aliphatic compounds (diesel, paint and laquer thinners, low-high boiling point hydrocarbons), alcohols, and ketones were all detected in site soils. These chemicals have similar environmental behavior to the halogenated VOCs selected by Jacobs (1989) as key chemicals, but are generally less toxic than these chemicals. Consequently, cleanup criteria developed for the halogenated VOCs will be protective for the non-halogenated compounds.

The key chemicals for assessing remedial action at the Jasco Site are:

Benzene	Tetrachloroethene
1,1-Dichloroethane	1,1,1-Trichloroethane
1,2 Dichloroethane	Trichloroethene
1,1-Dichloroethene	Vinyl Chloride
Methylene Chloride	

Actions taken to remediate these chemicals should also control the small amounts of other chemicals, including the petroleum-based compounds, that are present at the site.

#### 3.1 ENVIRONMENTAL FATE AND TRANSPORT

The environmental behavior of a particular chemical is dependent on the physical and chemical properties of the compound, the environmental transformation processes affecting them, and properties of the media in which it is located. Because the potential for exposure is highly dependent on the fate and transport of the chemicals of concern, these characteristics are discussed as part of the risk assessment. Chemicals of concern at the site include halogenated volatile organic compounds (VOCs) such as methylene chloride, chloroform, and tetrachloroethylene; total petroleum hydrocarbons (TPH); and monocyclic aromatic hydrocarbons (benzene, toluene, xylene, and ethylbenzene; BTXE). The properties of these chemicals are summarized below.

Volatile Organic Compounds. The volatile organic chemicals (VOCs) generally have relatively low organic carbon partition coefficients ( $K_{oc}$ s) indicating they are not likely to adsorb to the soil

organic matter. Most of these chemicals have solubilities in the hundreds-of-milligrams-per-liter range or greater (approximately 15,000 mg/liter or ppm for methylene chloride) and are expected to be fairly mobile in the aqueous phase (i.e. once they become dissolved in groundwater). Once in the groundwater, soluble organic chemicals are transported in the direction of groundwater flow, but at a slower rate than groundwater. This is because chemicals moving in groundwater partition between the mobile medium (groundwater) and the stationary medium (soil particles). The overall effect of this adsorption-desorption process is a reduction in the rate of a chemical's transport relative to the groundwater flow velocity.

Laboratory studies and field observations have shown that chlorinated aliphatic hydrocarbons can undergo both biological and abiological (physicochemical) transformations in soil and groundwater under the right conditions.

The halogenated VOCs are rather volatile and are likely to be released from uncovered vadose zone soils into the ambient air. The potential for compounds to volatilize from exposed subsurface soils can be predicted by their vapor pressure and/or Henry's Law constants, with compounds having high vapor pressures or Henry's Law constants generally volatilizing readily.

### 3.2 TOXICITY/HAZARD EVALUATION

Brief descriptions of the toxic effects of the key site chemicals is presented in the Jacobs' EA and this information is not repeated in this report. Oral toxicity criteria (Cancer slope factors for carcinogens and reference doses for noncarcinogens) are presented in Table 3. In order to establish media-specific toxicity criteria, an allowable exposure dose or target dose must be determined. For carcinogens, the target dose is generally a dose associated with a cancer risk range of  $10^{-4}$  -  $10^{-6}$ , with the  $10^{-6}$  dose level generally used as the target dose. For noncarcinogens, the verified reference dose (RfD) is used as the target dose. Target doses for the key chemicals are also presented in Table 3.

Media-specific toxicity criteria can be developed based on the target doses by using standard EPA assumptions. For establishing criteria for usable groundwater (i.e., water that can be used as a potable water supply), EPA assumes that the average person weighs 70 kg and drinks 2 liters of water per day. This approach is used by the EPA Office of Drinking Water to develop MCLGs and MCLs. The EPA Office of Drinking Water Maximum Contaminant Level (MCL) values, if available, are presented in Table 4. Criteria developed using the target doses together with the assumptions listed above are also presented in this table.

## 4.0 CLEANUP LEVEL DEVELOPMENT

### 4.1 EXPOSURE AND RISK ASSESSMENT

The conclusions of the Jacobs (1989) EA are that:

- o The site does not pose a significant health risk under current land-use conditions. The only complete exposure route was determined to be inhalation of volatile compounds and the potential cancer risk was determined to be less than  $10^{-6}$ .
- o Under future land-use conditions, the site could pose a significant risk via ingestion and inhalation of volatile compounds in groundwater used for domestic purposes. Jacobs (1989) estimated that a maximum plausible excess cancer risk of  $4 \times 10^{-3}$  for ingestion and  $6 \times 10^{-4}$  for vapor inhalation would be associated with use of groundwater in the A aquifer for domestic water supply.
- o Use of groundwater for domestic purposes would also pose significant non-carcinogenic risks.
- o Risks associated with exposure to contaminated soil by ingestion of surface soil or inhalation of fugitive dust were not significant.

OHM reviewed the Jacobs (1989) Endangerment Assessment and generally concurs with the conclusions of the report that the site does not currently pose a significant health risk but that under certain conditions, future use could pose a significant risk. The total mass of chemicals present in site soils was estimated by Jacobs to be too small to pose a risk as a result of inhalation exposure. The volatile chemicals present in site soils would not persist in surface soils and consequently are unlikely to be contacted by children with any regularity. These soils are also located immediately adjacent to the railroad tracks and will probably not be disturbed during any future construction.

Based on this EA, only the use of groundwater as a drinking water source was evaluated in detail in establishing cleanup criteria for chemicals at the Jasco site. Exposure to chemicals released into a residential dwelling constructed on site was not considered in the Jacobs (1989) report but will be addressed in this assessment.

Groundwater. As noted in the Jacobs (1989) Endangerment Assessment, groundwater in the upper aquifers (A and B1) in the area of the Jasco site is not currently used for domestic water supply. Under current conditions, Jacobs (1989) noted that site chemicals in groundwater did not pose a public health risk. However, use of the site could change in the future particularly as the area has been rezoned to residential use.

Exposure to materials from the site through use of contaminated groundwater requires that 1. the material is able to migrate through site soils in significant quantities or is present in the groundwater, 2. any groundwater this material contacts is of sufficient quantity and quality to be used as a groundwater source, and 3. the groundwater is used as a potable water supply well. Certain halogenated volatile organic compounds and lighter petroleum hydrocarbons have migrated to A-aquifer groundwater and in at least one location to the B(1)-aquifer. In addition, other organic compounds present in the vadose zone at the site could also migrate to these groundwater aquifers under certain conditions.

The presence of root casts and sandy interbeds provide an effective pathway for the vertical migration of target constituents to the A-aquifer. Lateral migration of target constituents in the vadose zone soil has occurred within the continuous coarse sand interbed about 15 feet below grade and along other discontinuous sandy interbeds. In the former drainage swale area and in on-site areas, downward percolation of precipitation and runoff is currently limited by the runoff collection system which directs runoff to the local sewer system.

Migration of dissolved halogenated volatile organic constituents in a northerly direction has occurred within the A-aquifer. Migration of target constituents from the drainage swale area appears to be limited to the more mobile chlorinated hydrocarbons such as 1,1,1-TCA, 1,1-DCA, 1,1-DCE and acetone. Less mobile target constituents such as petroleum hydrocarbon mixtures have not been detected in monitoring wells downgradient from the former drainage swale and underground storage tank areas.

The distribution of target constituents in the B(1)-aquifer suggests that the release occurred through a man-made conduit. A plume of three volatile organic constituents is currently centered downgradient of the former drainage swale area and the permeability of the aquitard separating the A- and B(1)-aquifers is such that vertical migration is unlikely. The lateral continuity of this aquitard both on site and at downgradient locations was established during the installation of the B(1)-aquifer wells. Lateral migration of target constituents within the B(1)-aquifer appears to be limited to the slow downgradient migration of the halogenated volatile organic constituents now centered at monitoring well I-2. The low permeability of the aquitard underlying the B(1)-aquifer and the lack of a nearby potential conduit makes vertical migration to underlying aquifers unlikely.

Use of the A and B(1) aquifers is generally restricted in order to prevent subsidence. In addition, a sample collected in May 1987 from the A-aquifer (well V-3) by Wahler Associates had levels of total dissolved solids (TDS; 3,100 mg/l) that slightly exceeded the TDS value of 3,000 mg/l that is used as a criteria under California's Proposition 65 for determining if water is a "source of drinking water." Primary drinking water standards (Maximum Contaminant Levels or MCLs) were exceeded for turbidity (130 NTU vs. MCL of 0.5-1 NTU) and coliform bacteria were detected in the water. The water also exceeded Secondary Drinking Water Standards for TDS (3,100 mg/liter vs. standard of 500 mg/l), chloride (540 mg/l vs. standard of 250 mg/l), color (30 color units vs. standard of 15 color units), iron (0.56 vs. standard of 0.3 mg/l) and manganese (4.5 mg/l vs. standard of 0.05 mg/l). Based on these results, the water in the A-aquifer appears to be of rather poor quality and would not be usable as a drinking water source without substantial treatment.

#### 4.2 RISK-BASED CLEANUP LEVELS

Groundwater. Jacobs (1989) modelled the migration of chemicals at the Jasco site using two models. The first model was a one dimensional analytical model that was used to evaluate the downward leaching of chemicals from vadose zone soils into the A-aquifer. A numerical model, SUTRA, was then used to model the downgradient migration of chemicals in the A-aquifer. The leaching model was developed based on the ratio of the maximum concentrations of methylene chloride in soil and groundwater. The concentration of other chemicals was then determined based on this ratio by using the highest value in soil or groundwater and the dilution factor from methylene chloride. The Jacobs (1989) modelling used data that included the heavily contaminated area of the drainage swale that was remediated in 1987.

The estimated groundwater concentration was then used as input into the numerical model to evaluate the migration in the A-aquifer. This model accounts for changes in concentration

associated with horizontal and vertical dispersion of the plume in the aquifer and migration of the plume past a point of exposure.

Target risk-based groundwater criteria and MCLs (which consider both risk and technical feasibility) for key chemicals are presented in Table 4. These values were used, together with the dilution factors from the Jacobs (1989) modelling effort, to determine allowable levels of chemicals in site soils. These values are presented in Table 5. In all cases the values based on the MCLs are higher than the values based on the target risk-based criteria alone. EPA considers attainability in preparing MCLs and this fact is probably responsible for the differences. Both values represent levels of exposure that are considered to be "safe" by EPA.

The models used to estimate migration by Jacobs (1989) are considered likely to overestimate migration as neither model considers retardation or decay. Volatile organic compounds will not move at the same rate as water, but will be slowed somewhat by the process of adsorption to soil particles. Some of the compounds are expected to become tightly bound to these particles and may not be readily desorbed back into the water column. Steinberg et al (1987) studied ethylene dibromide (EDB), a volatile halogenated compound, in agricultural soils and noted that residual EDB (as opposed to freshly added EDB) at concentrations up to 200 ug/kg, appeared to persist in soils much longer than predicted by most models. They found that the EDB was being trapped very tightly in soil micropores. Other compounds have not been studied to date, but it is possible that some amount of the volatile organic compounds would be trapped by this same process. In addition, both biological and chemical degradation processes will act to break down the compounds. Considering these factors, the small amount of volatile organic compounds that would remain in soils may not reach groundwater and if they reach groundwater may not reach a potential exposure point.

Indoor Air Exposure. Jacobs (1989) evaluated the potential risks associated with exposure to outdoor air at the Jasco site but did not consider the potential for indoor air exposure. For completeness, a qualitative evaluation of this pathway was included as part of this report.

Jacobs (1989) estimated the amount of each chemical present at the site and assumed that all this material would volatilize over a lifetime. Based on this analysis, they determined that the site did not pose a health risk for outdoor exposure. EPA (1989), in the Air/Superfund National Technical Guidance Study Series, estimated that 130 mg/m<sup>2</sup>-min is a reasonable estimate of volatile emissions from surface material while 0.4 mg/m<sup>2</sup>-min was determined to be a reasonable estimate of emissions from covered soils. Any residential structure that in the future is placed on the current Jasco property would almost certainly have a concrete floor which will be of rather low permeability. Chemicals in soils will tend to move to areas of higher permeability, and consequently, will tend to be released into outdoor areas. Over time, small cracks will occur in the concrete flooring and some migration of chemicals through these cracks could occur. However, considering the wide dispersion of chemicals on site and the low levels that will remain following remediation, it is unlikely that exposure via this pathway would pose a greater risk than that estimated by Jacobs (1989) for outdoor exposure to the entire mass of chemical.

#### 4.3 CLEANUP GUIDELINES FOR OTHER SITES

The California Regional Water Quality Control Board generally requires cleanup of volatile organic compounds (VOCs) to soil levels of approximately 0.5 to 1 mg/kg, based on the assumption that this level is unlikely to adversely affect water. Higher levels have been allowed on a case-by-case basis. This value is similar to the state of New Jersey ECRA criteria for VOCs of 1 mg/kg.



EPA (1990), in their proposed Corrective Action Rule for Solid Waste Management Units (40 CFR 264), presented examples of concentrations meeting criteria for action levels at solid waste management units (SWMUs) in several media including soils. The criteria for soils were developed based only on a consideration of soil ingestion and are inappropriate for volatile compounds which will generally not persist in soils that could be ingested (i.e., surface soils). These action levels also do not consider risks that could be associated with volatilization of the chemicals or leaching to groundwater. The action levels, which are risk-based and correspond to  $10^{-6}$  cancer risk levels or to reference dose levels, range from 8 mg/kg for 1,2-dichloroethane to 7,000 for 1,1,1-trichloroethane. Values were not presented for benzene or vinyl chloride. As noted, these values are inappropriate for this site but do indicate that the proposed site-specific cleanup levels would be protective for direct contact exposures.

#### 4.4 SOIL REMEDIATION LEVELS FOR THE JASCO SITE

In developing site-specific cleanup criteria for soils at the Jasco site, Jacobs (1989) did not evaluate the effects of retardation or degradation of the chemicals. A certain amount of the chemicals present in soils at the Jasco site are likely to be retained by soil carbon or in soil particle micropores or will be chemically degraded or degraded by soil microorganisms. Only small areas of the site contain chemicals, particularly following the excavation of the drainage swale area. Because the modelling effort assumed a larger area of the site was contaminated, the actual amount of dilution that would occur is likely to be greater than predicted by the Jacobs (1989) model.

Based on the potential effects of retardation, microbial and chemical degradation, and dilution, higher levels of VOCs than presented in Table 5 are considered unlikely to pose a health risk at the site. OHM proposes that a cleanup criteria (soil remediation level) of 1 mg/kg be used for all the carcinogenic volatile organic compounds except for vinyl chloride, which is a potent known human carcinogen. For vinyl chloride, OHM proposes a soil remediation level of 0.5 mg/kg. In order to protect against the effects of multiple exposure to chemicals, including those not considered as key site chemicals, OHM proposes that the total level of carcinogenic volatile organic compounds not exceed 5 mg/kg in soils.

For 1,1,1-trichloroethane, the only noncarcinogenic halogenated VOC, OHM proposes a soil remediation level of 50 mg/kg. This level is below any health-based criteria but is more consistent with values presented in the California Leaking Underground Fuel Tank Manual for other similar noncarcinogenic compounds such as toluene, xylene, and ethylbenzene. Other noncarcinogenic compounds that have been detected at the site primarily consist of the low to medium boiling point petroleum hydrocarbons. These compounds tend to be less mobile, more rapidly degraded, and in most cases less toxic than 1,1,1-trichloroethane. Consequently, OHM proposes that a soil remediation level of 50 mg/kg be used for these noncarcinogenic compounds. OHM also proposes that the total concentration of noncarcinogenic compounds not exceed 100 mg/kg. This level should be sufficient to protect against any adverse effects from mixtures of compounds, including mixtures of petroleum hydrocarbons.

Based on groundwater modelling conducted for the Endangerment Assessment, organic site constituents at the soil remediation levels noted above are unlikely to pose risks to individuals using the water in the A-aquifer as a drinking water source. The modelling conducted as part of the Jacobs Endangerment Assessment assumed that the chemicals of concern were present in soils at a uniform concentration. Because the dilution factors used in this assessment were based on this assumption, chemicals present in soils at levels slightly above the soil remediation criteria would probably not pose a health concern as long as the average concentration of the chemical in a particular area was below the criteria. Further considering that water from the A-aquifer would

probably not be used for domestic purposes because of its poor quality and the restrictions placed on its use by local agencies, low levels of chemicals remaining in site soils are unlikely to pose a substantial health risk.

## 5.0 CONCLUSIONS

Soil remediation levels have been developed for the Jasco site that are designed to adequately protect future on-site and nearby off-site residents from any potential health effects associated with the migration of chemicals in soils into groundwater that could be used as a domestic water source. These soil cleanup levels are:

### CARCINOGENS

Individual volatile organic compounds	- 1 mg/kg
Vinyl Chloride	- 0.5 mg/kg
Sum of all compounds	- 5 mg/kg

### NON-CARCINOGENS

Individual volatile organic compounds	- 50 mg/kg
Sum of all compounds	- 100 mg/kg

Cleanup levels for these compounds were developed based on a comparison with cleanup criteria used for other sites and a consideration of site-specific factors, including the potential for migration and the small amount of material present. The poor quality of the water in the A-aquifer and the restrictions placed on the use of this water by local agencies were not considered in developing the soil remediation levels but support.

In order to ensure that the health of on-site and off-site workers and any nearby residents is adequately protected, conservative (health protective; unlikely to underestimate risk) assumptions were used in deriving these soil remediation levels. Because of the use of these conservative (although not necessarily worst case) assumptions, it is unlikely that chemicals remaining at the site at these levels would pose an actual hazard.

## 6.0 References

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TABLE 1  
MAXIMUM SOIL CONCENTRATIONS DETECTED  
AT JASCO CHEMICAL CORPORATION

Contaminant	Highest Detected Concentration (mg/kg)	Date Sample Collected
Acetone	100 (270) <sup>a</sup>	1988 SB-10(B-8)
Benzene	0.008 (3)	1987 (Excavation)
Carbon Tetrachloride	ND (680)	1988 (B-8)
Chloroform	ND (2.3)	1988 (B-8)
1,1-Dichloroethane	3 (34)	1988 C-1(B-8)
1,1-Dichloroethene	1.7 (34)	1988 C-1(B-8)
1,2-Dichloroethane	ND (3.9)	1988 (B-8)
Ethanol	3.4 (20)	1988 SB-9(SB-3)
Ethylbenzene	14 (170)	1988 SB-12(B-8)
Isopropanol	164	1988 SB-9
Methanol	60	1990 C-1
Methylene Chloride	6.2 (3400)	1988 SB-9(B-8)
Methyl Ethyl Ketone	1.9	1988 SB-10
Petroleum Hydrocarbons as:		
Diesel	14	1988 B-12
Kerosene	10 (150)	1988 (SB-3)
Lacquer Thinner	10 (16)	1988 B-10(B-9)
Paint Thinner	7.3 (11,000)	1988 SB-10(B-8)
High Boiling Point	290	1990 S-1
Low to Med. Boiling Point	6700	1990 C-1
Tetrachloroethane	0.005 (16)	1988 S-4(B-8)
Tetrachloroethene	4	1990 C-1
Toluene	110 (1700)	1988 C-1(B-8)
1,1,1-Trichloroethane	61	1990 C-1
Trichloroethene	0.05 (490)	1988 C-1(B-8)
Xylene	37 (210)	1988 C-1(SB-4)

<sup>a</sup> Values in parentheses are maximum values from the excavated area of the drainage swale. Soils containing these concentrations have been removed.

ND - Not Detected

TABLE 2

MAXIMUM GROUNDWATER CONCENTRATIONS DETECTED  
JASCO CHEMICAL CORPORATION

<u>Contaminant</u>	<u>Highest Detected Concentration (mg/kg)</u>	<u>Date Sample Collected; Location</u>
Acetone	1.7	1989 V-4
Benzene	0.011 (0.02) <sup>a</sup>	1987 V-3(V-2)
Chlorobenzene	0.008 (0.037)	1987 V-4(V-2)
Chloroethane	0.39	1989 V-4
1,1-Dichloroethane	7.8	1989 V-4
1,1-Dichloroethene	0.19	1989 V-4
1,2-Dichloroethane	0.008	1987 V-4
Trans-1,2-Dichloroethene	0.2	1989 V-3
Ethanol	16	1989 V-4
Isopropanol	1.4	1989 V-4
Methanol	3.8	1990 V-3
Methyl Ethyl Ketone	(0.027)	1987 V-1(V-2)
Methylene Chloride	3.5 (142)	1987 V-4(V-2)
4-Nitrophenol	0.037	1990 V-1
Pentachlorophenol	0.05	1987 V-3
Phenol	0.02	1987 I-3
Toluene	0.017 (0.25)	1987 V-4(V-2)
Total Petroleum Hydrocarbons as:		
Diesel	33	1989 V-3
Paint Thinner	0.86	1984 V-1
1,1,1-Trichloroethane	1.7	1989 V-4
Vinyl Chloride	0.005	1990 V-4
Xylene	0.008 (0.05)	1987 V-3(V-2)

<sup>a</sup> Values in parentheses are the maximum values detected in well V-2 which was destroyed during the on-site excavation.

TABLE 3  
ORAL TOXICITY CRITERIA FOR  
KEY CHEMICALS AT  
JASCO CHEMICAL CORPORATION

<u>Chemical</u>	<u>Toxicity Criteria<sup>a</sup></u>	<u>Oral Target Dose<sup>b</sup></u>
<u>Carcinogens</u>	<u>Slope Factor (mg/kg/day)<sup>-1</sup></u>	<u>mg/kg/day</u>
Benzene	$2.9 \times 10^{-2}$ [A]	$3.4 \times 10^{-5}$
1,1-Dichloroethane	$9.1 \times 10^{-2}$ [B2]	$1 \times 10^{-5}$
1,2-Dichloroethane	$9.1 \times 10^{-2}$ [B2]	$1 \times 10^{-5}$
1,1-Dichloroethene	$6 \times 10^{-1}$ [C]	$1.7 \times 10^{-6}$
Methylene Chloride	$7.5 \times 10^{-3}$ [B2]	$1.3 \times 10^{-4}$
Tetrachloroethene	$5.1 \times 10^{-2}$ [B2]	$2 \times 10^{-5}$
Trichloroethene	$1.1 \times 10^{-2}$ [B2]	$9 \times 10^{-5}$
Vinyl Chloride	2.3 [A]	$4.3 \times 10^{-7}$
<u>Non Carcinogens</u>	<u>RfD mg/kg/day</u>	<u>mg/kg/day</u>
1,1,1-Trichloroethane	$9 \times 10^{-2}$	$9 \times 10^{-2}$

<sup>a</sup> Toxicity criteria are the EPA slope factor (cancer potency factor) for carcinogens and the reference dose (RfD) for non carcinogens.

<sup>b</sup> The oral target dose is the dose associated with a  $10^{-6}$  cancer risk assuming lifetime exposure for carcinogens and is the RfD for non carcinogens.



TABLE 4  
GROUNDWATER CRITERIA  
FOR KEY CHEMICALS AT  
JASCO CHEMICAL CORPORATION

Chemical	Risk-Based (mg/L) Concentration Based on Target Dose (Mg/L) <sup>a</sup>	MCL (mg/L) <sup>b</sup>
Benzene	0.0012	0.005
1,1-Dichloroethane	0.0004	NA <sup>c</sup>
1,2-Dichloroethane	0.0004	0.005
1,1-Dichloroethene	0.00006	0.007
Methylene Chloride	0.005	NA
Tetrachloroethene	0.0007	NA
1,1,1-Trichloroethane		0.2
Trichloroethene	0.003	0.005
Vinyl Chloride	0.00002	0.002

<sup>a</sup> Value assumes the average person weighs 70 kg and drinks 2 liters of water/day. Value (mg/L) = oral target dose (mg/kg/day) x 70 kg /2 L/day.

<sup>b</sup> Maximum Contaminant Level (MCL) under the Safe Drinking Water Act.

<sup>c</sup> Not available

TABLE 5

SOIL CLEANUP CRITERIA  
FOR KEY CHEMICALS AT  
JASCO CHEMICAL CORPORATION

Chemical	Dilution <sup>a</sup> Factor	Concentration Based on Target Dose(mg/kg) <sup>b</sup>	Concentration Based on MCL (mg/kg) <sup>b</sup>
Benzene	160	0.2	0.8
1,1-Dichloroethane	260	0.1	NA
1,2-Dichloroethane	360	0.1	2
1,1-Dichloroethene	240	0.01	2
Methylene Chloride	490	2	NA
Tetrachloroethene	290	0.2	NA
1,1,1,-Trichloroethane	400 <sup>c</sup>	1200	80
Trichloroethene	500	2	3
Vinyl Chloride	120	0.002	0.2

<sup>a</sup> Source: Jacobs (1989); Fractional difference between on-site soil concentration (mg/kg) and modelled 70 year average groundwater concentration (mg/L).

<sup>b</sup> Values defined by multiplying groundwater criteria from Table 4 by the dilution factor to determine allowable soil concentrations. Values do not account for attenuation on soil particles or chemical or biological degradation.

<sup>c</sup> Estimated value

PLAT SCALE = 1"=30'

OHM CORPORATION  
WALNUT CREEK, CA

DRAWN BY  
E. Kwong 12-18-90

CHECKED BY

APPROVED BY

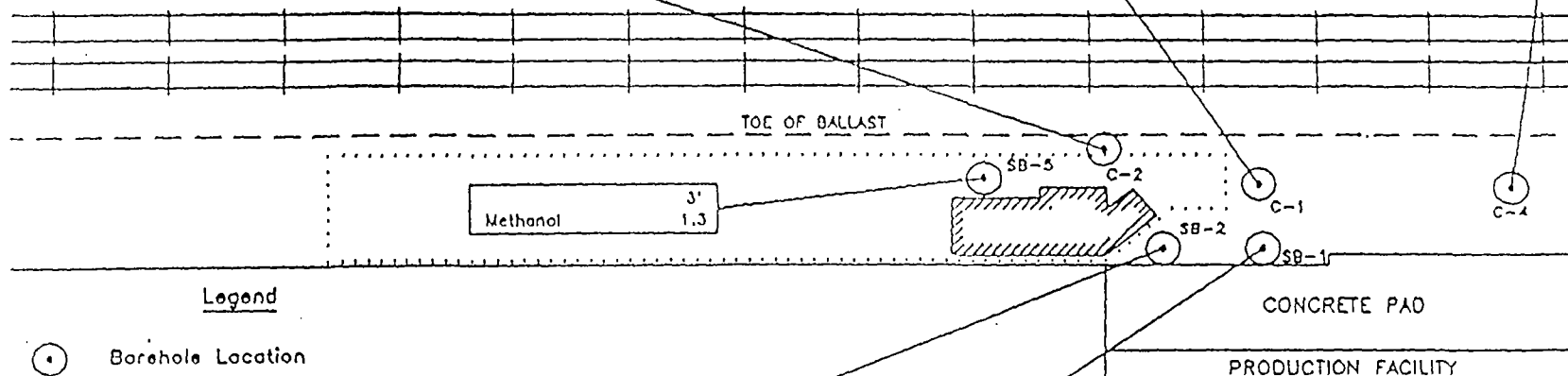
DRAWING NUMBER 0007403-A4.4

CENTRAL EXPRESSWAY

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.02	0.018	0.038	0.11	0.083	0.41	ND
1,1-DCE	ND	ND	ND	0.03	ND	0.036	ND
1,2-DCE	ND	ND	ND	ND	ND	0.015	ND
1,1,1-TCA	0.099	0.052	0.016	0.095	0.052	0.016	ND
Bromoform	ND	ND	ND	ND	ND	0.019	ND
Methylene Chloride	ND	ND	0.14	0.27	0.71	ND	ND
Trichloroethene	0.015	ND	ND	0.0073	ND	ND	ND
Low-Med BP HC	ND	ND	ND	2800	1300	2600	ND
Toluene	0.023	ND	ND	0.005	ND	0.085	0.018
Xylene	ND	ND	ND	0.01	ND	0.038	0.028

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.12	0.38	0.038	ND	0.72	2.2	J
1,1-DCE	0.39	1.7	0.025	0.17	0.24	0.15	ND
1,1,1-TCA	15	61	0.59	5.3	6.8	ND	ND
Bromoform	ND	ND	ND	ND	ND	0.17	0.11
Methylene Chloride	0.9	ND	0.75	ND	4.2	3.2	ND
Tetrachloroethene	ND	0.085	ND	0.052	ND	4	ND
Trichloroethene	ND	0.05	ND	ND	ND	ND	ND
Isopropanol	76	ND	ND	ND	ND	ND	ND
Methanol	60	ND	ND	ND	ND	ND	ND
Low-Med BPHC	2800	8700	170	1300	120	380	36
Toluene	37	110	1.1	3.4	4.1	6.3	1.4
Xylene	11	37	0.67	5.5	2.6	5.9	1.5
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.37

No concentrations  
exceeding detection  
limit.



Legend



Borehole Location

..... Impermeable Membrane Runoff Collection System

////// Area of Interim Soil Excavation

All concentrations of contaminants  
given in mg/kg

	3'
1,1-DCA	1.4
1,1,1-TCA	2.6
Acetone	6.3
Methylene Chloride	1.7
Toluene	0.3
Acetone	8.8
Methanol	5.0
TPH (Kerosene)	10
TPH (Paint Thinner)	5.2

	3'
1,1-DCA	0.54
1,1,1-TCA	1.1
Methylene Chloride	1.3
Acetone	1.1
Ethanol	0.7
Methanol	3.3

FIGURE 1

DISTRIBUTION OF TARGET CONSTITUENTS  
3-30', FORMER DRAINAGE SWALE, DS-1

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA



OHM Corporation

PLOT SCALE - 1"=30'

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WALNUT CREEK, CA	E. Kwong 12-18-90			0007403-A4.5

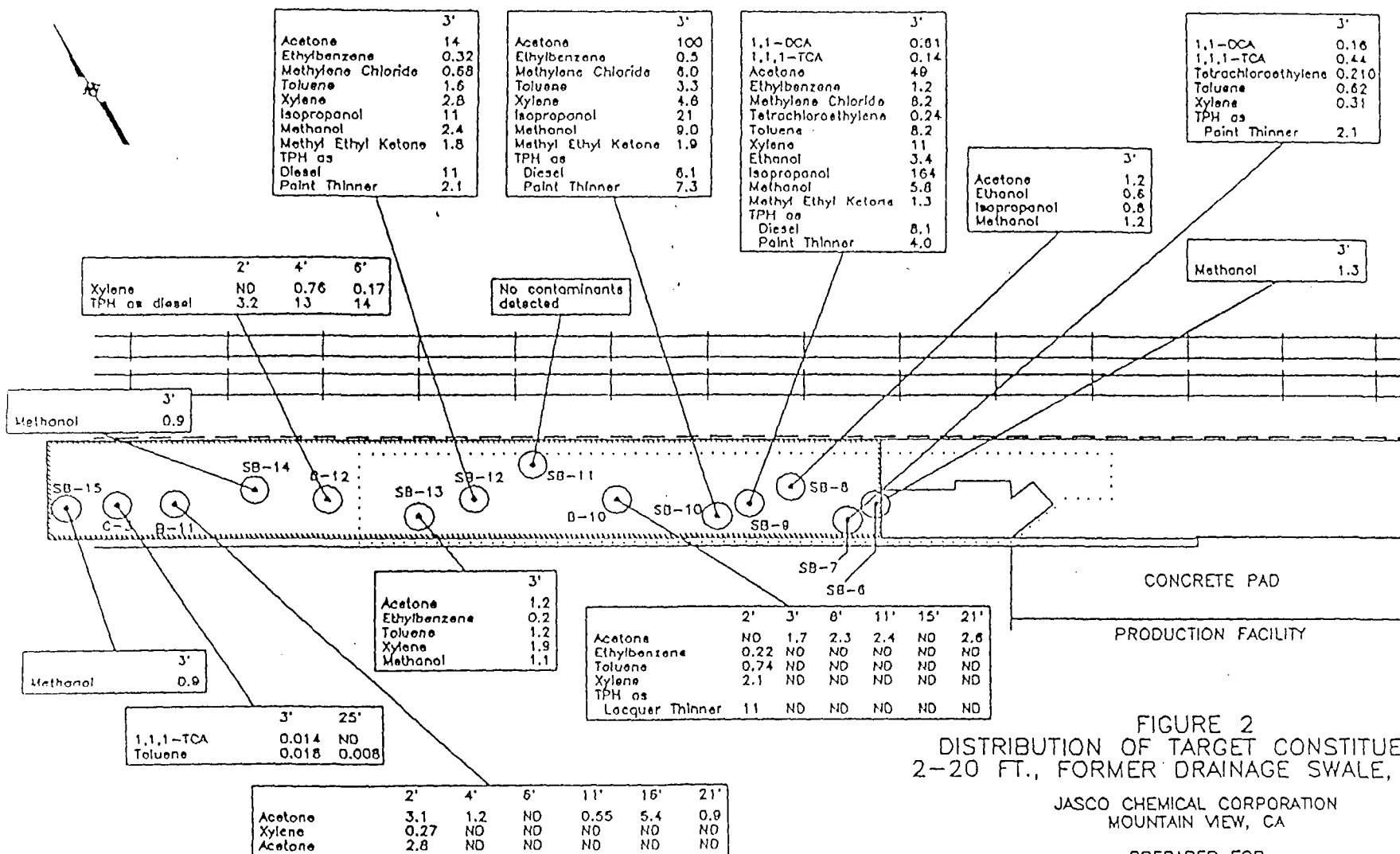


FIGURE 2  
DISTRIBUTION OF TARGET CONSTITUENTS  
2-20 FT., FORMER DRAINAGE SWALE, DS-2

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR  
JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

OHM Corporation

Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- All concentrations of contaminants given in mg/kg

PLOT SCALE - 1"=30'

OHM CORPORATION  
WALNUT CREEK, CA

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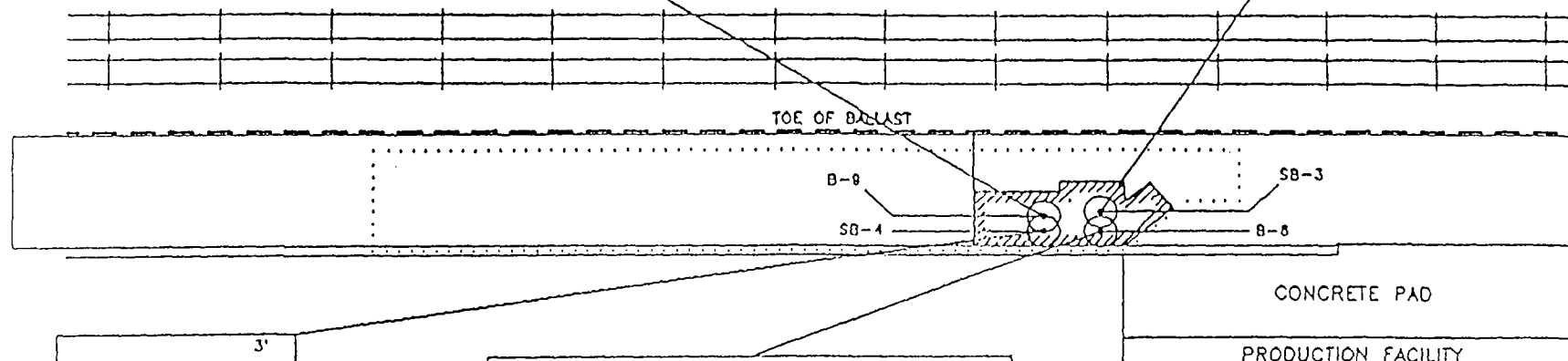
CHECKED BY

APPROVED BY

DRAWING  
NUMBER 0007403-A4.6

	2'	4'	6'	11'	15'	21'
1,1-DCA	ND	2.2	0.05	0.23	ND	ND
1,1-DCE	0.16	ND	ND	ND	ND	ND
1,1,1-TCA	0.34	30	28	0.28	ND	ND
2-Propanone	24	25	6.2	5.1	ND	ND
Bromodichloromethane	0.16	ND	ND	ND	ND	ND
Ethylbenzene	ND	3	4.2	ND	ND	ND
Methylene Chloride	9.3	42	21	7.4	10	15
Tetrachloroethane	ND	0.87	1.3	ND	ND	ND
TCE	ND	1.4	1.5	ND	ND	ND
Toluene	2.3	38	41	0.27	ND	ND
Xylene	0.45	18	27	ND	ND	ND
Acetone	16	25	1.0	27	12	4
Isopropanol	ND	1.5	ND	ND	ND	ND
TPH as						
Lacquer Thinner	18	ND	ND	ND	ND	ND
Paint Thinner	98	5000	2000	29	ND	ND

	3'
1,1,1-TCA	47
Acetone	81
Methylene Chloride	210
Toluene	38
Xylene	27
Ethanol	20
Isopropanol	18
Methanol	32
TPH as	
Kerosene	150
Paint Thinner	320



	3'
1,1-DCA	1.2
1,1,1-TCA	7.3
Acetone	28
Ethylbenzene	2.2
Methylene Chloride	84
Tetrachloroethylene	1.0
TCE	0.56
Toluene	17
Xylene	210
Isopropanol	60
Methanol	14
TPH as	
Kerosene	140
Paint Thinner	320

	3'	5'	10'	15'	20'
1,1-DCA	27	34	0.96	0.2	0.70
1,1-DCE	13	ND	ND	ND	ND
1,1,1-TCA	ND	1.5	22	2.3	0.21
1,2-DCA	3.9	ND	ND	ND	ND
Carbon Tetrachloride	650	ND	ND	ND	ND
Chloroform	2.3	ND	ND	ND	ND
Ethylbenzene	170	NA	NA	NA	NA
Methylene Chloride	3400	2.4	71	8.0	18
Tetrachloroethane	16	0.0067	0.31	ND	ND
TCE	490	ND	0.85	0.088	ND
Toluene	1700	NA	NA	NA	NA
Acetone	270	NA	15	NA	13
Isopropanol	3.5	NA	1	NA	2.5
TPH as					
Paint Thinner	11000	NA	2600	NA	20

Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- All concentrations of contaminants given in mg/kg

FIGURE 3  
DISTRIBUTION OF TARGET CONSTITUENTS  
2-30', FORMER DRAINAGE SWALE, OS-3

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA

PREPARED FOR

JASCO CHEMICAL CORPORATION  
MOUNTAIN VIEW, CA



OHM Corporation

APPENDIX E

EXPANDED EXTRACTION SYSTEM CALCULATIONS

## 1.0 INTRODUCTION

### 1.1 SCOPE OF METHODOLOGY

The methods described in this appendix were used to determine the range of extraction well systems which may be necessary to contain and treat groundwater at the JASCO site. The goal of an extraction system at the Site is to contain the flow of groundwater containing target constituents exceeding the ARARs and to direct this groundwater to extraction wells where it may be pumped from the aquifer and treated. Based upon the present distribution of target constituents in groundwater, this system should be effective at capturing groundwater passing beneath both the underground storage tank and former drainage swale areas. As the underground storage tank area is located upgradient from the former drainage swale area, the extraction system would be most effective in the vicinity of, or immediately downgradient of, the former drainage swale area.

### 1.2 DATA SOURCES

The hydrogeologic parameters used in evaluating these systems have been collected in association with aquifer testing and groundwater extraction at existing monitor well V-4. These data include results of step-drawdown and constant rate discharge aquifer tests and continuous monitoring of the pumping rate since 1987 when groundwater extraction was initiated. A submersible pump operating at a low continuous flow to limit drawdown is used to remove groundwater from the well. This groundwater is then directed through a plumbing system to the sanitary sewer system under Industrial Waste Discharge Permit 89037 as authorized by the City of Mountain View. Well V-4 was chosen for this purpose because of its proximity to the former drainage swale and its downgradient location from the production area and the underground storage tank area. This system has been in continuous operation since April 1987 with the exception of short periods of equipment maintenance.

### 1.3 OVERVIEW OF METHODOLOGY

The methodology utilized in assessing the potential extraction system design at the Site is based upon research concerning capture zones for pumping centers conducted by Javandel and Tsang (1986), Keeley (1984) and Keeley and Tsang (1983).

Given an homogeneous and isotropic aquifer of uniform thickness, a pumping well penetrating the full thickness will form a cone-shaped depression of the groundwater surface. Groundwater within this the cone of depression will be drawn to the pumping well. For a two-well system located along a line perpendicular to the direction of groundwater flow, there is a maximum separation distance such that all upgradient groundwater between the two wells will be captured by the wells and none will pass between them. A similar separation distance can be calculated for a well system consisting of any number of extraction wells. These calculations provide a method for determining the optimum number of wells and the separation distances between the wells that would be required to prevent downgradient migration past a given cross-section of the aquifer.

The following calculations should be considered only as approximations of the zone of capture. There are inherent limitations to the use of such models in the field. The accuracy of the calculations depend upon the accuracy of the estimates of aquifer characteristics. These conditions, however, may be variable based upon changes in the potentiometric surface or volume of groundwater recharge. In addition, these models assume a laterally and vertically homogeneous aquifer consistent with hydrogeologic conditions at the pumping well. Hydrogeologic conditions in the field are rarely homogeneous.

## 2.0 CALCULATIONS

### 2.1 ASSUMPTIONS

For the purpose of providing an estimate of the effectiveness of various groundwater extraction scenarios, a number of assumptions have been made:

- 1) The A-aquifer is a homogeneous aquifer with hydrogeologic parameters as estimated at monitor well V-4 from aquifer tests conducted during previous investigations. These parameters are listed below:

A-aquifer saturated thickness (b)	= 7 feet
hydraulic conductivity (K)	= 167.4 gal/day/ft <sup>2</sup>
hydraulic gradient (dh/dl)	= 0.004 ft/ft
transmissivity (T) = (K) x (b)	= 1171.8 gal/day/ft

- 2) Maximum sustainable discharge rates from the A-aquifer range from 0.5 gallons per minute (720 gallons per day) to 2.2 gpm (3168 gallons per day). These values represent the minimum and maximum discharge rates measured at the existing extraction well V-4 over the past four years. At present the sustainable discharge rate is assumed to be 1.0 gpm based upon recent pumping rates from monitor well V-4.

- 3) The hydraulic gradient (dh/dl), based upon the historic potentiometric surface of the A-aquifer, is 0.004 ft/ft.

### 2.2 VARIABLES

The variables in solving the equation of capture zones are:

Q	=	pumping rate (gal/day)
b	=	saturated thickness of aquifer (ft)
n	=	effective porosity
v	=	true pore velocity
K	=	hydraulic conductivity (gal/day/ft <sup>2</sup> )
dh/dl	=	hydraulic gradient (ft/ft)
T	=	transmissivity (gal/day/ft)

For clarity, pi is assumed to be equal to 3.14.

### 2.3 ZONE OF CAPTURE CALCULATIONS

The zone of capture is defined by two types of stagnation points. The downgradient stagnation point ( $r_d$ ) is the point directly downgradient of the extraction well from where groundwater is no longer drawn towards the pumping well but rather moves in the direction of regional groundwater flow. This point represents the downgradient edge of the zone of capture. The cross-gradient stagnation points ( $r_c$ ) are the two points perpendicular to the direction of groundwater flow from an extraction well from where groundwater is no longer drawn towards the well but rather moves in the regional direction of groundwater flow. These points represent the cross-gradient edges of the zone of capture.



The relationship of  $r_d$  to the aquifer variables is:

$$r_d = \frac{Q}{(2 \times \pi)(b)(n)(v)}$$

This equation can be further defined for the variables which have been measured at the Site during past investigations using the following relationships:

$$v = (K/n) \times (dh/dl) \quad \text{and} \quad K = \frac{T}{b}$$

By incorporating these relationships, the downgradient stagnation point can be estimated using:

$$r_d = \frac{Q}{(2 \times \pi)(b)(n)(K/n)(dh/dl)} \quad \text{or}$$

$$r_d = \frac{Q}{(2 \times \pi)(K)(b)(dh/dl)}$$

Solving for the downgradient stagnation point ( $r_d$ ) using the present sustainable pumping rate of 1.0 gallons per minute yields:

$$\begin{aligned} r_d(1.0) &= \frac{1440 \text{ gpd}}{(2 \times \pi)(167.4 \text{ gpd/ft})(7 \text{ ft})(0.004 \text{ ft/ft})} \\ &= 49 \text{ ft} \end{aligned}$$

The relationship of  $r_c$  to the aquifer variables is:

$$r_c = \frac{(r_d \times \pi)}{2}$$

Solving for Site conditions, using the present sustainable pumping rate of 1.0 gallons per minute yields:

$$\begin{aligned} r_c(1.0) &= (49 \text{ ft} \times \pi)/2 \\ &= 77 \text{ ft} \end{aligned}$$

Similarly, these calculations can be made using the maximum and minimum recorded pumping rates from extraction well V-4.

At the maximum pumping rate of 2.2 gallons per minute, the downgradient and cross-gradient stagnation points are calculated to be:

$$\begin{aligned}r_d(2.2) &= 108 \text{ feet} \\r_c(2.2) &= 169 \text{ feet}\end{aligned}$$

At the minimum pumping rate of 0.5 gallons per minute, the downgradient and cross-gradient stagnation points are calculated to be:

$$\begin{aligned}r_d(0.5) &= 24 \text{ feet} \\r_c(0.5) &= 38 \text{ feet}\end{aligned}$$

## 2.4 SEPARATION DISTANCES

In an extraction system consisting of two extraction wells located along a line perpendicular to the direction of groundwater flow, the optimum distance between the two wells ( $d_2$ ) can be calculated by:

$$d_2 = \frac{Q}{(\pi)(K)(b)(dh/dl)}$$

The optimum separation between two wells pumping at the minimum rate of 0.5 gpm is:

$$\begin{aligned}d_2(0.5) &= \frac{720 \text{ gpd}}{(\pi)(167.4 \text{ gpd/ft})(7 \text{ ft})(0.004 \text{ ft/ft})} \\&= 49 \text{ ft}\end{aligned}$$

Similarly the optimum separation distance between two wells pumping at the present rate of 1.0 gpm and the maximum rate of 2.2 gpm are:

$$\begin{aligned}d_2(1.0) &= 98 \text{ ft} \\d_2(2.2) &= 215 \text{ ft}\end{aligned}$$

In an extraction system consisting of three extraction wells, the optimum distance between each well pair ( $d_3$ ) is approximately 1.25 times the value of  $d_2$ . Using this relationship the optimum distances between each of three wells pumping at the minimum, present and maximum pumping rates are:

$$\begin{aligned}d_3(0.5) &= 61 \text{ ft} \\d_3(1.0) &= 123 \text{ ft} \\d_3(2.2) &= 269 \text{ ft}\end{aligned}$$

### 3.0 POTENTIAL EXTRACTION SYSTEM DESIGNS

The goal of the groundwater extraction system is to extract that portion of the groundwater which contains target constituents in excess of ARARs and to prevent the downgradient migration of target constituents. The center of the present plume of target constituents in groundwater is essentially at the location of present extraction well V-4 in the former drainage swale. Since this well is located almost directly downgradient from the underground storage tank area, an extraction system designed to capture groundwater from the former drainage swale area should also be effective at capturing groundwater which has passed beneath the underground storage tank area.

Groundwater contamination is believed to be limited to the portion of the former drainage swale at the northwestern boundary of the Site. Monitor well V-5, located at the northeastern corner of the Site approximately 150 feet cross-gradient from well V-4, does not contain target constituents at detectable concentrations. Soil samples collected from near surface depths to the west of well V-4 contained elevated levels of target constituents, however, soil samples collected to the depth of groundwater at a point approximately 150 feet west of well V-4 did not contain target constituents at detectable levels.

The optimum extraction well system would contain and extract groundwater across an approximately 100 to 150 foot wide cross-section of the aquifer centered at well V-4. A system with a shorter cross-gradient zone of capture may allow downgradient migration of target constituents. A system with a longer cross-gradient zone of capture may draw in excessive amounts of uncontaminated water thus limiting the effectiveness of any associated treatment system.

The discussions of potential extraction well designs will be divided by system size (i.e. one-well, two-well and three-well systems). The maximum sustainable pumping rate will likely be the dominant factor in determining the effectiveness of extraction at achieving the plume containment goal.

#### 3.1 ONE-WELL EXTRACTION SYSTEM

As well V-4 is located near the center of the present plume of target constituents and is currently utilized for groundwater extraction, the one-well extraction system could be operated without the installation of additional wells.

At the present sustainable pumping rate of 1.0 gallons per minute, the value of  $r_c$  is estimated at 77 feet. At this rate, the present extraction well V-4 is capable of containing groundwater along a 150 foot wide cross-section of the A-aquifer centered at the center of the plume of target constituents (Figure D-1). Such a system should be sufficient to contain and extract the present plume of target constituents in groundwater.

At the minimum rate of 0.5 gpm, the effectiveness of the one-well system would be reduced to approximately 75 feet (Figure D-1). This system would be capable of extracting the groundwater containing the greatest quantity of target constituents but may not be effective at containing the full width of the target constituent plume. Periods of such low pumping rate have been limited to severe drought conditions.

At the maximum rate of 2.2 gpm, the one-well system should be able to contain groundwater along a cross-section of the A-aquifer exceeding 300 feet (Figure D-1). This system would be capable of

containing groundwater flow in the direction of groundwater flow across the entire length of the former drainage swale area and the northern property boundary of the Site and would likely extract a significant quantity of uncontaminated groundwater. To prevent this occurrence, flow could be restricted to limit the recovery of uncontaminated groundwater while continuing to contain the full width of the target constituent plume.

### 3.2 TWO-WELL EXTRACTION SYSTEM

Because of the limited extent of the plume of target constituents in A-aquifer groundwater, a two-well extraction system would be feasible only under maximum sustainable discharge rates of less than 1.0 gpm. At higher discharge rates, the two-well system would recover a significant volume of uncontaminated groundwater. At the minimum pumping rate of 0.5 gpm the optimum separation distance would be 49 feet and the system would be capable of containing and extracting groundwater along a 125 foot cross-section of the A-aquifer (Figure D-2). Allowing the system to pump at a higher discharge rate such as the present 1.0 gpm would result in interference between the pumping centers and a decrease in extraction efficiency. Such a system would be most effective when maintained at the lower pumping rate.

Designing the system for a flow rate of 1.0 gpm or greater would require a separation distance of over 100 feet. While this system could easily contain the full width of the target constituent plume, it would also extract a significant volume of uncontaminated groundwater. In addition, if flow rates were to decrease the system may not be able to prevent groundwater containing target constituents from migrating downgradient between the two wells.

### 3.3 THREE-WELL EXTRACTION SYSTEM

The three-well extraction system discussed here assumes that the wells would be located along a line perpendicular to the direction of groundwater flow with the middle well located at existing well V-4. Considering the size of the plume of target constituents and the facility constraints (e.g. Southern Pacific (SP) rail lines), this configuration is assumed to be the most feasible three well configuration.

As with the two-well system, a three-well extraction system at the Site would be feasible only under low pumping conditions. At the minimum pumping rate of 0.5 gpm the optimum separation distance would be 61 feet and the system would be capable of containing and extracting groundwater along a 200 foot cross-section of the A-aquifer (Figure D-3). Even at this low pumping rate, the system would likely extract a significant volume of uncontaminated groundwater from outside of the plume of target constituents. Allowing the system to pump at a higher discharge rate such as the present 1.0 gpm would result in interference between the pumping centers and a decrease in extraction efficiency. Such a system would be most effective when maintained at the lower pumping rate.

### 3.4 EXTRACTION SYSTEMS OF FOUR OR MORE WELLS

During the evaluation of potential extraction systems a number of other configurations were considered. Among these were linear systems of greater than three wells and systems with non-linear configurations.

No linear systems consisting of greater than three wells were found to be feasible. Considering the optimum separation distances, such systems would require placement of extraction wells at

locations where groundwater is known to be uncontaminated. Even at the lowest pumping rates, these systems would extract a significant volume of uncontaminated groundwater.

While multiple-well systems placed in circular or other non-linear configurations are common in the control of contaminant plumes, none were found to be feasible under Site conditions. The plume of groundwater containing target constituents is limited to a relatively small area of the Site. Such systems would not be feasible because: 1) they may result in the separation of the plume into smaller plumes which would be more difficult to recover; 2) they may result in the extraction of uncontaminated groundwater; and 3) they could require the construction of piping and associated features that could impact the SP rail lines.

#### 4.0 CONCLUSIONS

Based upon existing hydrogeologic data and the models for calculating the zone of capture of various extraction well systems, the most feasible system under the present maximum sustainable pumping rate would be a single well extraction system at existing well V-4. Such a system would be capable of both containing the plume of target constituents in groundwater and extracting groundwater containing target constituents in excess of ARARs.

Should maximum pumping rates continue to be variable at the Site, a two- or three-well extraction system may also be feasible. Such a system could be maintained at a lower discharge rate that would be less affected by variations in aquifer conditions.

Additional evaluation of potential extraction system configurations should be conducted during the remedial design stage. These evaluations should be based upon the most recent hydrogeologic and pumping rate data to ensure the most effective choice of system configuration. As any remedial actions concerning the soil within the former drainage swale area will impact groundwater quality, a decision of extraction system necessity and scope would be best made after the effects of soil remediation have been realized. Not doing so may result in the construction of unnecessary extraction wells and treatment facilities.

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